09/881,909

English language equivalent to JP 06-064094 according to STIC also machine translation of JP 06-064094 included here.

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DERWENT-WEEK: 199343

TITLE: Fluid storage system - comprises gas-tight metallic foil laminated to fluoro:polymer clad polyamide film, and has good mechanical integrity and strength

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ABSTRACTED-PUB-NO: EP 567383A

BASIC-ABSTRACT:

A multilayer laminated prod. of improved resistance to permeation comprises at least one gas-tight metallic foil laminated to at least one fluoropolymer clad polyimide film.

Also claimed are the following (i) a multilayer laminated composite comprising the multi-layer laminated prod. and at least one fluoropolymer film thermally welded to the multilayer film, the fluoropolymer film comprises PTFE and/or thermally compatible TFE copolymers, and at least one of the outermost surfaces of the fluoropolymer layer comprises unfused PTFE; (ii) a fluid storage system comprising a shell and a flexible sealed liner located within the shell, the liner being oversized relative to the shell so as to reduce stress or tension on the liner seams; (iii) a fluid storage system comprising (a) a fluid tight shell, (b) a flexible barrier positioned over the storage tank contents to prevent evaporation of fluid contents into the tank overhead, the barrier is held in place adjacent to the top of the shell and has sufficient material to allow the barrier to droop under gravity, in accordance with changes in vol. of the contained fluid, and (c) a vent means for permitting flow of air (1) into and out of the shell above the barrier as the barrier rises and falls with the fluid contents, or (2) into and out of the barrier.

Pref. the metallic foil is sandwiched between and laminated to at least two polymer films, at least one of the polymer films comprises a fluoropolymer clad polyimide film. The laminated prod. pref. includes a conductive materual comprising carbon particles and/or metallic particles incorporated into one or more of the adhesive layers. The fluoropolymer clad polyimide film pref. comprises a layer of polyimide and one or more layers of fluoropolymer selected

from (1) PTFE and/or thermally compatible TFE copolymers, (2) PVF2 and/or thermally compatible VF2 copolymers, and/or (3) PCTFE and/or thermally compatible CTFE copolymers. The metallic foil is selected from Al, Cu, Sn, Pb and corrosion resistant steel alloy pref. stainless steel, and has a thickness of 0.0013-0.0076 cm (0.00254-0.0038 cm).

USE/ADVANTAGE - As storage tanks motor vehicle fuel, aq. chemicals, and non-aq. chemicals. The fuel liner material has mechanical integrity and strength, and can withstand the permeation and deleterious effects of liq. hydrocabron fuels and fuel additives, alcohols and ethers.

CHOSEN-DRAWING: Dwg.5A/10

TITLE-TERMS: FLUID STORAGE SYSTEM COMPRISE GAS TIGHT METALLIC FOIL LAMINATE FLUORO POLYMER CLAD POLYAMIDE FILM MECHANICAL INTEGRITY STRENGTH

DERWENT-CLASS: A14 A26 A92 P73 Q13 Q34

CPI-CODES: A04-E08; A04-E09; A05-J01B; A12-P03; A12-P05;

UNLINKED-DERWENT-REGISTRY-NUMBERS: 5085U

ENHANCED-POLYMER-INDEXING:
Polymer Index [1.1]
017 ; R00975 G0022 D01 D12 D10 D51 D53 D59 D69 D82 F* 7A ; R00363 G0555 G0022 D01 D12 D10 D51 D53 D58 D69 D82 F* 7A ; R00458 G0022 D01 D12 D10 D53 D51 D59 D69 D82 F* 7A Cl ; R00360 G0555 G0022 D01 D12 D10 D51 D53 D58 D69 D82 Cl 7A ; R00326 G0044 G0033 G0022 D01 D02 D12 D10 D51 D53 D58 D82 ; R00708 G0102 G0022 D01 D02 D12 D10 D19 D18 D31 D51 D53 D58 D88 ; S9999 S1285*R ; P1081*R F72 ; H0000 ; H0011*R ; P1592*R F77 ; P0635*R F70 ; P1003 P0964 P1081 H0260 F34 F72 ; P0793 ; P0806 ; P1332 ; P1150 ; P1741 ; P0511 ; P1161 ; P1752
Polymer Index [1.2]
017 ; R00822 G1025 G0997 D01 D11 D10 D50 D82 F28 F26 ; S9999 S1285*R ; H0011*R ; P0884 P0839 H0293 F41
Polymer Index [1.3]
017 ; D11 D10 D20 D18 D32 D50 D93 ; S9999 S1285*R ; H0293 ; P0839*R F41
Polymer Index [1.4]
017 ; ND10 ; ND01 ; B9999 B4864 B4853 B4740 ; Q9999 Q7818*R ; K9712 K9676 ; K9552 K9483 ; K9574 K9483 ; K9698 K9676 ; K9701 K9676 ; K9745*R ; N9999 N6166 ; N9999 N7192 N7023 ; Q9999 Q9289 Q9212 ; B9999 B4035 B3930 B3838 B3747 ; K9416 ; B9999 B5301 B5298 B5276 ; B9999 B4091*R B3838 B3747 ; Q9999 Q9234 Q9212 ; Q9999 Q8480 Q8399 Q8366 ; B9999 B4626 B4568 ; B9999 B5163 B5152 B4740
Polymer Index [1.5]
017 ; D00 D09 Gm ; R05085 D00 D09 C* 4A ; A999 A135 ; S9999 S1456*R ; A999 A771

POLYMER-MULTIPUNCH-CODES-AND-KEY-SERIALS:
Key Serials: 0004 0020 0031 0147 0150 0153 0207 0209 0210 0218 0221 0224 0226 0231 0239 0240 0245 0304 0305 0310 0815 0816 0821 0836 0837 0842 0843 0844 0849 0947 0948 0953 0954 0955 0960 0968 0969 0974 1279 1283 1285 1288 1291 1294 1311 1319 2211 2319 2419 2454 2513 2541 2542 2547 2608 2628 2629 2680 2726 2728 2788 2829 3178 3188 3228 3252 3255 3258 3300
Multipunch Codes: 017 02& 034 038 04- 040 041 046 047 055 056 062 063 064 071 08& 087 088 090 10- 141 143 144 147 15- 150 153 166 169 17& 17- 170 171 27- 307 308 342 381 393 42& 431 435 44& 443 454 47& 477 479 494 50& 52& 54& 540 541 548 551 560 566 567 57& 597 600 651 655 672 684 688 720 725

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(54) **Fluid storage tanks and liners.**

(57) A fluid storage system comprising a shell 42, and including a flexible, seamed liner 40 located within the shell. The liner is made oversized relative to the shell so as to reduce stress or tension on the liner seams. Particularly useful as liner materials are gas-tight metallic foils laminated to at least one fluoropolymer clad polyimide film.

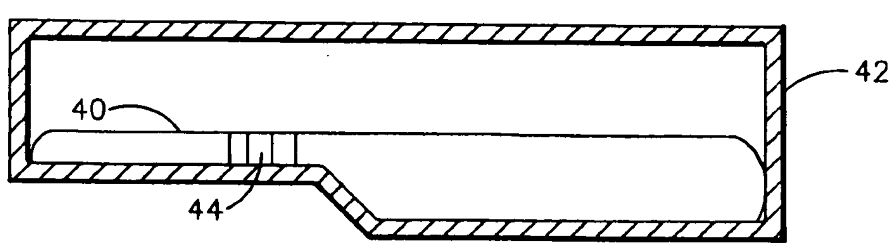

FIG.5A

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Background of the Invention

Field of the Invention

The present invention relates to improvements in fluid storage tanks, and in particular to improvements in flexible liner systems for fluid storage tanks. The invention has particular utility in connection with fuel storage tanks for motor vehicles, and will be described in connection with such utility, although other utilities are contemplated.

Liquid fuels for internal combustion engines and for heating typically comprise refined hydrocarbons. Such materials are highly energetic and flammable, but they can cause severe environmental damage if released or spilled. Such materials can range in viscosity from 10 centipoise to 1,000 centipoise, and generally comprise a blend of carbon chain compounds with molecular weights as low as 54, and selected additives such as tetraethyl lead, phosphorus compounds, volatile alcohols, and ethers, which additives may be present in quantities ranging from trace, catalytic amounts, up to 30 wt percent or more of the fuel. Alcohols also are used as primary components of liquid fuels and are being considered for more extensive use.

The widespread use of volatile liquid fuels creates large requirements for containment and storage. These requirements range from extremely large multi-million gallon storage tanks as may be employed in a refinery or distillery, to intermediate volume storage tanks (10,000-50,000 gal) as may be employed in retail gasoline stations, to smaller volume tanks (250-1000 gal) as may be employed, for example, in single family residences, to small volume tanks (1-100 gal) as may be employed in motor vehicles, and farm and garden implements. These tanks typically have been formed of steel or plastic, such as glass fiber reinforced polyester, polyethylene or nylon.

Metal tanks and plastic tanks each have their advantages and disadvantages. Metal tanks are relatively strong, are inert to attack by hydrocarbons, and are able to dissipate static electrical charges. Metal tanks also are relatively inexpensive and have excellent containment properties and permeability resistance. However, metallic tanks can be subject to attack by contained liquids, or in the case of underground tanks, by soil components, which may cause rust or corrosion which may lead to microscopic or to large scale failure of the tank wall. Corrosion resistant metals are available, but are heavy and expensive. Metal tanks are relatively heavy which is a disadvantage for tankage in vehicles or other on-board applications.

Plastic tanks are lightweight and can be fabricated by a number of techniques including blow molding, rotational molding and injection molding. Plastics have good strength, and individual plastics can be selected which have excellent compatibility with individual fuel components, for example, nylon for hydrocarbons, and polyethylene for alcohols. However, the diversity of fuels now being used and/or contemplated makes it difficult if not impossible to use one single plastic material without risking attack by some fuel component. Also, even though the plastic may exhibit mechanical compatibility with its fuel contents, there can be a high rate of transport of fuel molecules through the wall of the plastic.

The art has proposed several techniques for improving the resistance to permeability of plastic fuel tanks such as surface fluorination of polyethylene, surface sulfonation of polyethylene, alloying of polyolefins with barrier materials such as nylon, addition of mineral platelets such as mica and coextrusion or co-blow molding with packaging resins. These approaches all show significant reduction of the permeability to some fuel components. However, they only reduce the rate of permeation and do not improve the chemical resistance of the base resin to the contained liquid. Moreover, there are questions concerning the ability of these materials to deter permeation of some chemical components now being considered for fuels. And there are questions concerning the long term effectiveness of surface treatments in impeding permeation.

The art also has proposed several techniques for improving the integrity of fuel storage tanks. For example, it is now a common practice to fit new metal or plastic tanks or to retrofit existing metal or plastic tanks with a secondary containment means, e.g. by means of a double walled tank or a separate containment vessel surrounding the tank. Alternatively, the tank may be provided with a liner or bladder made of a flexible plastic or elastomer.

Another problem with fuel tanks is repetitive venting of vapors to the atmosphere each time the tank is refilled. In a conventional fuel tank, the space above the liquid fuel becomes saturated with fuel vapors. Thus, when the tank is refilled, the saturated vapors become displaced from the tank, and unless captured in a vapor recovery system, are released to the atmosphere. Various systems have been developed for vapor recovery, but are cumbersome, and at times heavy as well as expensive, and may require frequent service. The problem of venting of vapors to the atmosphere is particularly acute in the case of relatively small volume fuel storage tanks as are employed on motor vehicles, farm and garden implements, and the like which require frequent filling. As an alternative to conventional vapor recovery systems, it has been proposed to eliminate the free vapor space by providing a conventional rigid fuel tank with a flexible liner or bladder which contains the liquid,

but which is sufficiently flexible and conformable to the shape of the liquid that there is little or no vapor or overhead space inside the bladder. The liner or bladder is fitted inside the rigid, liquid-tight tank, and supported by the tank.

By choosing a liner or bladder which has sufficient permeation resistance to molecules of the contained liquid, permeation and evaporation of fuel into overhead space in the rigid tank can be prevented, since the liner which contains the liquid fuel conforms to the shape or volume of the contained liquid. While an overhead space in the rigid tank still would exist, and grow as the fuel is consumed, the liner prevents fuel vapors from migrating into and filling the overhead space. Thus, the overhead space would contain virtually no permeating fuel molecules, and would consist almost entirely of ambient air. When the tank is filled, the liquid enters directly into the liner which then expands to conform to the rigid tank. And, only air is displaced from the overhead space of the rigid tank. Thus, there would be no venting of fuel vapors to the atmosphere.

Over the road tank haulers have also employed flexible tank liners to increase profitability. For example, one tank hauler reportedly has outfitted its tankers with two flexible liners, one liner designed for use when hauling lubricating oils in one direction, and the other liner designed for use in hauling orange juice in the other direction.

Currently commercially available flexible tank liner or bladder materials exhibit relatively high permeability, particularly to lighter hydrocarbons such as highly refined gasoline, and gasoline additives such as alcohols. Moreover, currently available flexible tank liner or bladder materials and liners or bladders made therefrom have limited burst strengths, and can be particularly weak at fabricated seams. This presents a problem since motor vehicle fuel tanks may be subjected to extreme mechanical stress when liquid fuels rebound as a result of rapid deceleration or particularly in the event of a collision. Moreover, since a rigid fuel tank shell also may be damaged in a collision, failure of a tank liner may result in catastrophic loss of the fuel contents, thus damaging the environment and increasing the possibility of fire or explosion.

A tank liner or bladder must maintain both flexibility and mechanical integrity and strength over the design life of the tank in which it is installed, and must provide the necessary barrier and chemical compatibility properties. A tank liner also must have sufficient thermal capabilities to survive manufacturing conditions, and in-use conditions without loss of barrier properties or mechanical strength. For example, in the case of a motor vehicle fuel tank, it is not uncommon in extreme northern areas for ambient temperatures to reach 50-60°F or more below zero, while ambient temperatures in some desert regions of the world may reach 130°F or more above zero. Moreover, even in temperate climate zones, the temperature under a motor vehicle may reach 200°F or more in the vicinity of the fuel tank.

It is therefore an object of the present invention to provide a liquid fuel tank storage system which overcomes the aforesaid and other disadvantages of the prior art. Another object of the present invention is to provide a liquid fuel liner material and manner of design and construction which is particularly suited for use in storage of liquid hydrocarbon fuels or the like, and is characterized by mechanical integrity and strength, and the ability to resist both permeation and deleterious effects of liquid hydrocarbon fuels and fuel additives, alcohols, ethers and the like.

Summary of the Invention

We have found in accordance with one aspect of the present invention that certain of the fluoropolymer clad polyimide film products disclosed in our co-pending U.S. Application Serial No. 07/717,855 advantageously may be employed as a flexible liner or barrier material in a fuel tank or the like. In yet another and preferred embodiment of the present invention, at least one gas-tight metallic foil may be sandwiched between and laminated to the fluoropolymer clad polyimide films or other polymer films.

Yet another aspect of the present invention provides a method of preparing a multilayer composite which comprises thermally welding together one or more fluoropolymer clad polyimide films and one or more metallic foils. The invention in yet another aspect provides a unique seam or splice which combines the characteristics and advantages of a peel seam, but retains the ultimate tensile and breaking strength of a shear seam. Finally, yet another aspect of the invention provides a storage tank assembly including an outer rigid tank shell, and an oversized flexible liner or bladder which is designed to protect against bursting.

Brief Description of the Drawings

Yet other features and advantages of the present invention will become clear from the following detailed description taken into conjunction with the enclosed drawings wherein like numerals depict like parts, and wherein:

FIG. 1 is a side view, in cross section, of a preferred laminate product made in accordance with the present

invention;

FIG. 2 is a schematic view showing production of a laminate product in accordance with the present invention;

FIG. 3 is a side view, in cross section, showing a storage tank and liner made in accordance with the present invention;

FIG. 4 is a side view, in cross section, showing details of the inlet portion of the storage tank shown in FIG. 3;

FIGS. 5A-5C are side views, in cross section, illustrating effective rapid deceleration;

FIG. 6 is a side view, in cross section, showing the shear seam;

FIG. 7 is a side view, in cross section, illustrating a peel seam;

FIG. 8 is a side view, in cross section, showing a peel/shear seam made in accordance with the present invention;

FIG. 9 is a side view, in cross section, illustrating a peel/shear seam of FIG. 8, under pressure; and

FIG. 10 is a side view, in cross section, illustrating another embodiment of the invention.

Detailed Description of the Invention

We have found that the fluoropolymer clad polyimide film products disclosed in our co-pending U.S. application Serial No. 07/717,855 advantageously may be employed as flexible liners or bladder barrier materials in a fuel tank. More specifically, as taught in our aforesaid copending U.S. application Serial No. 07/717,855, which is incorporated herein by reference, a multi-layer film is made by combining a layer of polyimide and one or more layers of a thermally weldable fluoropolymer film or films selected from a group consisting of PTFE (polytetrafluoroethylene, a homopolymer of tetrafluoroethylene (TFE monomer), thermally compatible TFE copolymers and any combination or blend thereof. The term TFE copolymers as used herein includes copolymers of TFE with other ethylenically unsaturated monomers, such as HFP (hexafluoropropylene) and known as FEP (fluorinated ethylene propylene); or with ethylene and known as ETFE; or with propylene and known as "Aflas"; or with perfluoroalkyl vinyl ethers such as perfluoromethyl vinyl ether (MFA) or perfluoropropyl vinyl ether (PFA). The fluoropolymer layer or layers also may be selected from the group consisting of PVF_2 (polyvinylidene fluoride or PVDF, (a homopolymer of vinylidene fluoride (VF_2) monomer), thermally compatible VF_2 copolymers (copolymers of vinylidene fluoride (VF_2) with other ethylenically unsaturated monomers, such as CTFE (chlorotrifluoroethylene) or HFP) and any blend or combination thereof. The term "copolymer" used herein includes the employment of one or more ethylenically unsaturated comonomers, such as both HFP and VF_2 as comonomers with TFE in a polymer (TFE terpolymer).

As taught in our aforesaid co-pending U.S. application Serial No. 07/717,855 the fluoropolymer clad polyimide multi-layer composites are prepared by coating a polyimide-containing film with an adhesive layer comprising a material selected from the group consisting of PTFE, thermally compatible TFE copolymers, and blends thereof; coating the adhesive layer on at least one surface of the polyimide containing film with a fluoropolymer film; applying a second fluoropolymer film to the adhesive layer on at least one surface of the polyimide-containing layer; and thermally welding the layers to form a composite. While PTFE may be employed alone as the adhesive layer material, it is more desirable from a processing point of view to utilize a combination of PTFE and a thermally compatible TFE copolymer to create this bond, since the use of PTFE alone necessitates processing temperatures which at times may lead to degradation of the strength of the polyimide or polyimide/fluoropolymer interface. Thermally compatible TFE copolymers should be used, meaning these copolymers must be co-processable with PTFE so as to provide a fused blend of the polymers with good physical properties. Such processing methods are described in co-pending U.S. Application Serial No. 07/305,748 assigned to the common assignee, and in U.S. Patent No. 4,883,716, both of which are incorporated herein by reference. Particularly useful as polyimide films for use in the present invention are those polyimide films disclosed in U.S. Patent No. 3,616,177, the disclosure of which also is incorporated herein by reference. Kapton^R H and Kapton^R HN may be used in the polyimide layer, as well as other polyimide films such as Apical^R or Upilex^R. The polyimide film layer typically should have a thickness of about 0.5-2.0 mil, more typically 0.7-1.3 mil.

The PTFE used in the present invention typically should have a relatively high molecular weight, and a melt viscosity of at least 10^{10} poise, preferably 10^{10}-10^{12} poise at 380°C. PTFE for use in the present invention may be derived from aqueous dispersion of such materials as Teflon^R 30, AD^R 1, and Fluon 81 and Algoflon^R 60. The PTFE may be combined with a thermally compatible TFE copolymer, such as FEP and PFA or MFA, to form the adhesive layers of the composite. When FEP is used, it typically should have a melting point of about 268°C and a melt viscosity of in the region of $3X10^4$-$2.5X10^5$ poise at 372°C. FEP may be derived from aqueous dispersion of such materials as Teflon^R 120, Teflon^R TE 9503, and Teflon^R TE 5582.

If PFA is used in the adhesive layers of the invention, it typically should have a melting point of 305°C and a melt viscosity in the region of $3X10^4$-$2.5X10^3$ poise at 372°C. PFA may be derived from aqueous dispersion of a material such as Teflon^R 322 J. The adhesive layers may be applied by either coating or lamination techniques. Typically the layers are formed by aqueous dispersion coating.

The adhesive layers typically should contain at least 40% by volume PTFE, with the remainder being A TFE copolymer with which it is thermally compatible. A useful composition for the adhesive layers is 50% by volume PTFE and 50% by volume thermally compatible TFE copolymer. The resulting composites are found to be resistant to delamination even at elevated temperatures, and are flexible and strong. These properties, together with excellent resistance to permeation by most hydrocarbon fuels makes the fluoropolymer clad polyimide films of our copending U.S. Application Serial No. 07/717,855 useful as liners or bladders in fuel tanks in accordance with the present invention. However, other commercially available fluoropolymer clad polymer films advantageously may be employed directly, i.e. without further cladding even if the cladding may contain less than 40% PTFE or they may be further clad in accordance with the foregoing. Suitable commercially available fluoropolymer clad films include Apical AF from Applied-Apical Company, particularly Apical AF919, Kapton F available from Dupont Company particularly Kaptan F 919, Upilex C from ICI Americas, particularly Upilex C 25RCB05F, and Chemfilm^R DF 2919 from Chemfab Corporation, particularly Chemfilm D2919-2.0 mil.

In another embodiment of the present invention, a thin metallic foil such as 0.0005 - 0.003 inch (0.00127-0.00762 cm) metal foil such as aluminum, copper, tin, lead or stainless steel or other corrosion resistant steel foil, preferably aluminum or copper, most preferably aluminum, is sandwiched between layers of fluoropolymer clad polyimide films or between layers of other relatively high modulus or "stiff" polymer films such as biaxially oriented condensation polymer film of polyethylene terephthalate and ethylene glycol (PET). PET film is commercially available from a number of sources including Mylar from DuPont and Melinex from ICI Americas. Also, if desired, the PET film may be clad with polyvinylidene chloride, urethanes or other cladding materials. Other films which may be used in place of PET film include biaxially oriented polyamide (nylon), non-fluoropolymer clad polyimide, polyetherimide available as Kemid from the Norton Company, biaxially oriented polyethylene naphthalate (PEN) available from ICI Films, polybenzimidazole (PBO), and polybenzoxazole available from Dow Chemical, and biaxially oriented polyolefins such as polyethylene or polypropylene. Such materials can be clad with polyvinylidene chloride, urethanes or other cladding materials. Such materials also can be clad with polyvinylidene chloride (PVDC), thin glass or may be metallized to improve their barrier properties. Other polymer film materials which advantageously may be employed in accordance with the present invention include polystryene, polyamide, a copolymer of ethylene and vinyl alcohol (EVAL), and polyvinylidene chloride. In such cases adhesives used to bond the layers of plastic materials to the metal foil, may include copolymers of ethylene and vinyl acetate, copolymers of ethylene and maleic anhydride, acrylics, urethanes, acrylic-urethanes and "ionomeric" materials. The polymer film layers may be preformed, or may be formed in situ directly on the metal foil. Alternatively, the plastic film layers may be preformed, and the metal foil formed in situ by depositing the metal on the polymer film.

The laminate consisting of metal foil sandwiched between two PET films is produced by coating the films with a highly chemical resistant adhesive and subsequently laminating them to the metal foil on a hot laminator. The adhesive may be polyester resin based, for example, Adcote 1217, Morton International or Adcote 506-40, Morton International and is crosslinked by isocyanate to improve its chemical resistance and bond strength of the laminate. The isocyanate used in this process can be TDI (for example Catalyst F, Morton International) or MDI (PAPI 2027, Dow Chemical Co.). The ratio resin/isocyanate can be between 100/2 to 100/8 depending on the system. The coating weight of the adhesive mixture should be 3-4 lbs. per 3000 sq. ft. (4.8824-6.5099 grams/sq. meter). The laminated product needs 5-8 days at room temperature to fully cure.

The laminate can be seamed by using the same adhesives as for the lamination, or other suitable adhesive. Typically, the seams are coated, pressed together and the adhesive at least partially cured. For example, for seaming with Adcote, the coated seams are dried and then pressed together at 180°-250°F (82-121°C) (Adcote 506-40) or 275-300°F (135-149°C) (Adcote 1217). The seams are then cooled under pressure and only then removed from the press. Five to eight days at room temperature are required for a full cure of the seams.

As an alternative, PET with a heat sealable surface (e.g. Melinex 301H, ICI Films) may be used. Then the seams are made by standard heat sealing techniques (e.g. bar sealing at 285-295°F (141-146°C), 40 psi, (275.8 dynes/sq. centimeter), 1 sec or by hot air sealer at nozzle temperatures 200-250°C and speeds 3-6 fpm). Other adhesive systems may be employed under their design conditions.

The thickness of the PET films typically should be .00025 inch to .003 inch (0.0006 to 0.0076 cm), more typically .0005 inch to .0012 inch (0.0013 to 0.0030 cm), most typically .0005 inch (0.0013 cm). The thinner the gauge of the film among 0.0005 to 0.002 inch (0.0013 to 0.0051 cm), the better the protection of the film against the formation of pinholes when flexed.

Metal foils are well known for resistance to permeation. Thus, the incorporation of a thin metal film or foil

in the laminated product may prevent permeation of certain components of hydrocarbon fuel blends which otherwise might permeate the polymer film layers. The polymer film layers also may protect the metal foil from corrosion or embrittlement by preventing direct liquid contact with many of the fuel components.

However, aluminum or other metal foils sufficiently thinned to be considered flexible (0.0005-0.003 inch) (0.0013 to 0.0076 cm) generally are extremely prone to damage and pin holing upon light flexing, bending or extension. We have found that resistance to pin holing may be substantially improved by laminating the foil between fluoropolymer clad polyimide films in accordance with one embodiment of the present invention. Moreover, resistance to pin holing appears to be achieved notwithstanding repeated flexure and even elongation of the laminated product. While not wishing to be bound by theory, it is believed that the fluoropolymer adhesive creates interstitial bonds between the foil and the polyimide film layers whereby the mechanical demands of flexure and elongation are transferred at least in part to the polyimide film layers which supports and stabilizes the foil layer. Should some pin holes form in the metal foil layer, the fluoropolymer clad polyimide film elements retain sufficient integrity to block or at least retard permeation through any pin holes which may form in the foil layer.

If desired, conductive materials such as carbon particles or metallic particles also may be incorporated into the adhesive layers to render the resultant material static dissipative. Typically, but not necessarily, the conductive materials will be incorporated into the laminated product elements nearest the liquid. Also typically, but not necessarily, the sames will be arranged so that the conductive layers in the liner are continuous allowing a single grounding of the liner to ground the entire liner.

Referring now to FIG. 1 of the drawings, there is illustrated a preferred form of flexible liner laminated film product made in accordance with the present invention. The film, in a preferred embodiment of the invention comprises a 0.0003-0.005 inch (0.0008 to 0.0013 cm) aluminum foil layer 10 sandwiched between and laminated to 0.002 inch (0.0051 cm) fluoropolymer clad polyimide film layers 12 and 14, respectively.

Typically but not necessarily fluoropolymer clad polyimide film layers 12 and 14 comprise the same fluoropolymer clad polyimide materials, and may be the same or different thicknesses, depending on the intended use. Typically aluminum foil layer 10 may be of a thickness in the range of 0.0005-0.003 inch (0.0013 to 0.0076 cm), more typically 0.001-0.0015 inch (0.00254-0.0038 cm), while fluoropolymer clad polyimide film layers 12 and 14 should have thickness of at least 0.0005 inch (0.0013 cm) typically will have a thickness of .0015-.005 inch (0.0038-0.0127 cm), more typically .00125-.003 inch (0.0032-0.0076 cm), most typically .0015-.0025 inch (0.00254-0.0064 cm).

Referring now to FIG. 2, the laminated product is formed as follows:

The aluminum foil layer 10 is first primed with a thin layer 0.0001-0.001 inch (0.000254-0.00254 cm) typically 0.00025-0.0005 inch (0.00065-0.0013 cm) of the fluoropolymer based primer (e.g. FEP alone or a blend of fluoropolymers or the materials described by Effenberger and Keese U.S. Patent 4,770,927, which is incorporated herein by reference, or with a special primer, Product Code 858-150, Dupont, designed to bond PTFE to aluminum). This primer is applied on both sides of the foil in a conventional dip coating tower. An additional fluoropolymer based top coat such as a blend of fluoropolymers or PTFE and fluoroelastomer (i.e. Latex TN -Ausimont) as is described in the aforesaid U.S. Patent 4,730,927 of J.A. Effenberger and F.M. Keese, may be applied in the same fashion to assure a good bond to the adjacent layers.

Polyimide film layers 12 and 14 are coated in a similar way with an aqueous dispersion of a fluoropolymer such as PTFE, PFA, FEP, MFA, or mixtures or blends. The coated layers then are laminated together in a hot laminator with the aluminum foil layer sandwiched between them.

Aluminum foil layer 10, and polyimide film layers 12 and 14, each are initially coated, at a coating station 100 with an aqueous dispersion of a fluoropolymer such as PTFE, PFA, FEP, MFA or mixtures or blends thereof. The coatings are applied in a conventional dip coating tower, and the coated layers are then laminated together with the aluminum foil layer sandwiched between the polyimide film layer in a hot laminator at a laminating station 102.

The resulting multilayer fluoropolymer clad polyimide film product is subjected to Gelbo flex testing using a modified commercially available Gelbo Tester available from U.S. Testing, Inc., Hoboken, New Jersey, as follows: The Gelbo test is similar to that described in ASTM F392-74 (Standard Test Method for Flex Durability of Flexible Barrier Materials).

Test conditions are as follows:

Two (2) cycles at full flex

Speed is 60 cycles/minute

A sample of 8.0 inch x 11.5 inch (20.32 x 29.21 cm) is formed into a cylinder of 8.0 inch (20.32 cm) height, and clamped top and bottom into the machine. To create the flex the top cylindrical surface is rapidly rotated and driven toward the lower cylindrical surface for a rotation in excess of 360 degrees. This causes the material to twist into a rope-like form. The machine then quickly reverses itself to untwist and straighten the sample

back into a cylindrical shape. This cycle defines one "flex" of the sample. By viewing the sample over a light box, any pinhole breach of the metallic foil can then be determined. When the metallic foil is micro-managed by the polyimide as previously described, the composite resists pinholing when severely flexed in the Gelbo tester. Test results indicated the composite could withstand two flexes with no pinholing, and additional flexes with only minor pinholing. This result was far superior to any other method of "protecting" the metallic barrier.

In another test, 1 mil polyimide clad with 0.5 mil fluoropolymer on each side was laminated to both sides of 1.3 mil primed aluminum foil. Several samples of this material were tested in the Gelbo flex tester and the following relationship was measured between number of flexes and number of pinholes observed in the sample:

No. of Flexes	Number of Pinholes
0	0
2	0
5	1
15	10
25	15*

*Includes 5 relatively large pinholes (approx. 1 mm diameter).

The Gelbo flex test of the polyester/foil composite revealed that the number of pinholes decreases with the decreasing thickness of the polyester film used:

Gauge. in.	Number of Pinholes After 2 Flexes
0.003	8
0.002	4
0.001	2
0.0005	1

As a further indication of the integrity of the micro-management of the foil by the fluoropolymer clad polyimide film product (said clad polyimide being bonded to each face of the foil) Instron tensile samples that had undergone considerable extension (30%-50%) with a width reduction of 20% showed no signs of delamination other than in the immediate vicinity of the break, and in fact showed no pinholing when viewed over a light box.

Referring to FIG. 3, the material is cut, formed and seamed using a hot seamer into a shape substantially to conform to the size and the shape of a rigid or semi-rigid tank shell 20. Alternatively, shell 20 may comprise a rigid plastic shell with vent holes to allow air to escape, or a mesh or other binding means for supporting the liner. Typically, the material will be cut, formed and seamed so that it is slightly oversized, e.g. 3 to 15%, depending on other factors such as size and geometry so that when the shaped product is installed and unrolled inside a rigid or semi-rigid tank shell, and the tank filled, any stress or tension will be taken not by the seams, but rather by the tank shell. The liner or bladder 30 is then folded and inserted into the existing tank 20 and affixed to the tank at the filler junction 24 of the tank 22.

Referring also to FIG. 4, an apertured reinforcing collar 26, formed, for example, of 0.005 inch (0.0127 cm) fluoropolymer clad glass substrate material, such as CHEMGLAS™ Premium 5 mil available from Chemfab Corp., typically is heat laminated around the inlet hole 28 of the liner 30, and the liner is bolted or clamped to the tank at 32. For fixed position storage tanks such as underground or above ground storage tanks the liner or bladder 30 may be supported and held in place by means of support hoops or stays 34 or the like. Thus, the liner 30 may be employed in new tank construction, or for retrofitting existing tanks.

Referring to FIGS. 5A-5C, in the case of installation of the liner into a tank of a motor vehicle or the like, the liner or bladder 40 typically is made sufficiently oversized relative to the size of the rigid or semi-rigid tank 42 so as to permit rapid expansion or elongation of the liner in order to accommodate a sudden rush of fuel, for example, in the case of rapid deceleration due to a collision. Thus, for example, the liner 40 may be made

10 to 15% oversized, and the liner 40 may be pleated or bunched at 44 to permit the rapid expansion and elongation of the liner without unduly stressing the liner. Since the liner 40 is quite thin, the bunched material does not appreciably reduce the capacity of the tank.

As noted supra, repetitive flexing of a foil clad laminate may result in damage to and pinholing of the foil. Accordingly, for on-board motor vehicle and the like use in which the tank may be subjected to several hundred fillings over the lifetime of the vehicle, it may be preferred to employ a non-foil laminate product formed of plastic materials selected for resistance to the intended fuel contents. The use of a non-foil laminate product, while perhaps not one hundred percent impervious to all of the liquid fuel volatiles, still should substantially reduce or essentially eliminate volatiles in the vapor volume over the liquid and thus substantially reduce or essentially eliminate venting of volatiles during filling.

As is well known in the art, shear seams 50 (FIG. 6) provide the strongest seam in tensile and breaking strength. However, shear seams are not considered desirable in forming a fuel tank liner or bladder since a shear seam will permit exposure of the unprotected laminate edges 52 to the fuel. Exposure of the unprotected edges may permit liquid to migrate or permeate through the laminate at the exposed edges 52, and/or may cause deterioration of the laminate and/or corrosion of the metal foil. Peel seams 54 (FIG. 7) protect the edges 56 of the laminate against exposure to the fuel; however, peel seams are relatively weak in tensile and breaking strength. While a peel seam may be employed in the case of a fixed position fuel tank, a peel seam does not have sufficient strength to be employed in forming a tank liner or bladder for a motor vehicle.

Accordingly, and in accordance with yet another aspect of the present invention, we have devised a combination peel/shear seam which combined the advantages of, but none of the disadvantages of peel and shear seams by themselves. Referring in particular to FIG. 8, a combination peel/shear seam or splice is formed in accordance with the present invention by folding the edges of the laminate back on themselves, and sealing the folds at the overlap area 64, for example, by heat sealing. The resultant seam thus provides single face contact, i.e. as in the case of a peel seam, and the ultimate tensile and breaking strength of a shear seam. Thus, as shown in FIG. 9 when the seam is challenged, for example, by pressure of a rush of contained liquid, the seam holds until its seam strength is reached. The peel portion of the seam then releases, which in turn release a certain amount of energy and permits the volume of the liner or bladder to increase. Pressure then is applied to the shear portion of the seam for ultimate strength, and thus providing a further margin of safety.

Referring to FIG. 10, the polymer laminate materials made in accordance with the present invention also may advantageously be employed as flexible overhead air bags or barriers 60 positioned over the fuel tank liquid contents 62, for occupying the tank overhead 64 and thereby preventing evaporation of fuel vapors into the tank overhead 64. In such case, the tank should be provided with vent means 66 for permitting flow of air into and out of the overhead barrier as the barrier rises and falls with the fuel contents 62. Barrier (bag) 60 is positioned at the top of the tank and has sufficient extra material to allow the barrier to droop, under gravity, as the fuel level falls, or changes volume as a function of the pressure differential caused by removal of fuel or changes volume as a function of ambient temperature changes, essentially to maintain contact with the liquid fuel and prevent any fuel vapors from forming overhead where they may then escape to the atmosphere.

While the invention has been described in connection with a preferred embodiment in providing a tank liner or bladder for a fuel tank, it will be understood that the invention also may advantageously be used for the containment of both aqueous and non-aqueous chemicals. Also, different polymer materials and different adhesives may be employed for the several layers. For example, an aluminum foil may be laminated between a polyester outer film layer and a polyimide inner film layer. Also, the tank liner made in accordance with the present invention may comprise two or more separate bags, one inside the other, formed of the same or different laminate materials. For example, for use as a fuel tank liner, inner liner may comprise a laminate of fluoropolymer clad polyimide which is impervious to the hydrocarbon components of the fuel, while the outer liner may comprise a laminate of PET laminated to foil which is impervious to alcohols. The inner and outer liners may be laminated or mechanically fixed to one another adjacent their respective inlet holes to form a common inlet, but preferably are otherwise free of one another.

As has been delineated above, permeation resistant bladders cover two basically different applications and the invention described here covers both applications.

One group of applications involves from 100 to over 2000 fillings and requires lessening loss of fuel molecules both during service and during filling. These applications require a material which is flexible and conforms to the shape of the contained fuel. Onboard fuel containment applications would principally fall into this group. These applications typically may make use of laminate constructions without foil.

The other class of applications may involve a large number of fillings and require zero or extremely low permeation to a broad variety of fuel molecules. Underground storage tanks or other tanks which will require very long life and/or extremely low permeation rate will normally fall into this group. Such applications should normally benefit from foil laminates. Because metal foil is incorporated into the bladder, these applications typ-

ically may use stays or other methods to hold the bladder extended. This approach means that the only flexing of the bladder occurs during installation and limits the number of flexes.

Some applications may require an extremely low level of permeability, such as is offered by foil, but also require the high level of flexibility provided by a non-foil construction. Another element of this invention is a "bag-in-a-bag" concept where an outside bag of very high permeability resistance (preferably foil containing) encloses a flexible inside bag (preferably not foil containing). The outside bag would preferably fit inside of a tank or overpack to provide mechanical integrity.

Claims

1. A multi-layer laminated product of improved resistance to permeation characterized by comprising at least one gas-tight metallic foil 10 laminated to at least one fluoropolymer clad polyimide film (12,14).

2. A multi-layer laminated product according to claim 1, characterized in that said metallic foil 10 is sandwiched between and laminated to at least two polymer films (12,14), at least one of which polymer films comprises a fluoropolymer clad polyimide film.

3. A multi-layer laminated product according to claim 1, characterized in that said fluoropolymer clad polyimide film (12,14) preferably comprises a layer of polyimide and one or more layers of fluoropolymer selected from: (1) PTFE, thermally compatible TFE copolymers and a combination or blend thereof; (2) PVF_2, thermally compatible VF_2 copolymers and a combination or blend thereof; (3) PCTFE, thermally compatible CTFE copolymers and a combination or blend thereof; or (4) PTFE, thermally compatible TFE copolymers, blends thereof, PVF_2, thermally compatible VF_2 copolymers, blends thereof, PCTFE, thermally compatible CTFE copolymers and blends thereof.

4. A multi-layer laminated product according to claim 1, characterized in that said metallic foil is selected from aluminum, copper, tin, lead and a corrosion resistant steel alloy, preferably stainless steel, and wherein said metallic foil preferably has a thickness of 0.0013 to 0.0076 cm, preferably 0.00254 to 0.0038 cm.

5. A multi-layer laminated composite characterized by comprising the multi-layer laminated product of claim 1, and at least one fluoropolymer film, thermally welded to the multi-layer film, which fluoropolymer film comprises a fluoropolymer selected from PTFE, thermally compatible TFE copolymers, and a combination or blend thereof, and wherein at least one of the outermost surfaces of the fluoropolymer layer preferably comprises unfused PTFE.

6. A multi-layer laminated product according to claim 1, and characterized by including a conductive material, preferably carbon particles, metallic particles or mixtures thereof, incorporated into one or more of the adhesive layers.

7. A fluid storage system characterized by comprising a shell 42 and including a flexible, seamed liner 40 located within said shell, said liner being oversized relative to said shell so as to reduce stress or tension on liner seams 64.

8. A fluid storage system according to claim 7, characterized in that said liner preferably is 3-15% oversized, said liner preferably including at least two seamed liners located one within the other, the outer of the two seamed liners 40 preferably comprising a foil laminate, and wherein said shell 42 comprises a rigid or a semi-rigid shell, or a mesh or other apertured binding means for supporting the liner.

9. A fluid storage system according to claim 8, characterized in that said shell includes one or more apertures 24 for permitting flow of air into and out of said shell.

10. A fluid storage system characterized by comprising a fluid tight shell and including a flexible barrier 60 positioned over the storage tank contents 62 for occupying the tank overhead and thereby prevent evaporation of fluid contents into the tank overhead, said barrier being held in place adjacent the top of the shell, said barrier having sufficient material to allow the barrier to droop, under gravity, in accordance with changes in volume of the contained fluid, and including vent means 66 for permitting flow of air (a) into and out of the shell above the barrier as the barrier rises and falls with the fluid contents, or (b) into and out of said barrier.

11. A method of installing a liner in a storage tank characterized by providing a liner having a shape and size which is oversized relative to the tank and introducing and deploying the liner within the tank.

12. A method according to claim 11, characterized by including the step of maintaining the liner against the inside walls of the shell by means of hoops or stays.

13. A splice for joining distal edges of a flexible material, characterized in that the joining edges are folded back upon themselves in an overlap area 64 whereby the distal edges 52 of the material are disposed to one side of the splice.

14. A splice according to claim 13, characterized in that said material preferably comprises a meltable material whereby it may be heat laminated to itself in the overlap area, and wherein said material preferably comprises a gas-tight metallic foil laminated to a polymer film, preferably a fluoropolymer clad polyimide film, or said material preferably comprises a vinylidene chloride containing polymer, a urethane clad polymer film, a biaxially oriented condensation film, a biaxially oriented condensation polymer of polyethylene terephthalate and ethylene glycol, or a polymer film selected from polyamide, polyimide, polyetherimide, polyethylene naphthalate, polybenzimidazole, polybenzoxazole, polyethylene, polystyrene, a copolymer of ethylene and vinyl alcohol and vinylidene chloride.

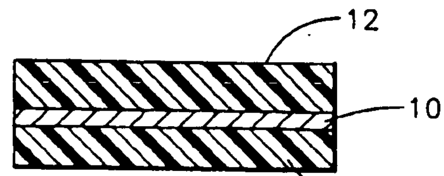

FIG.1

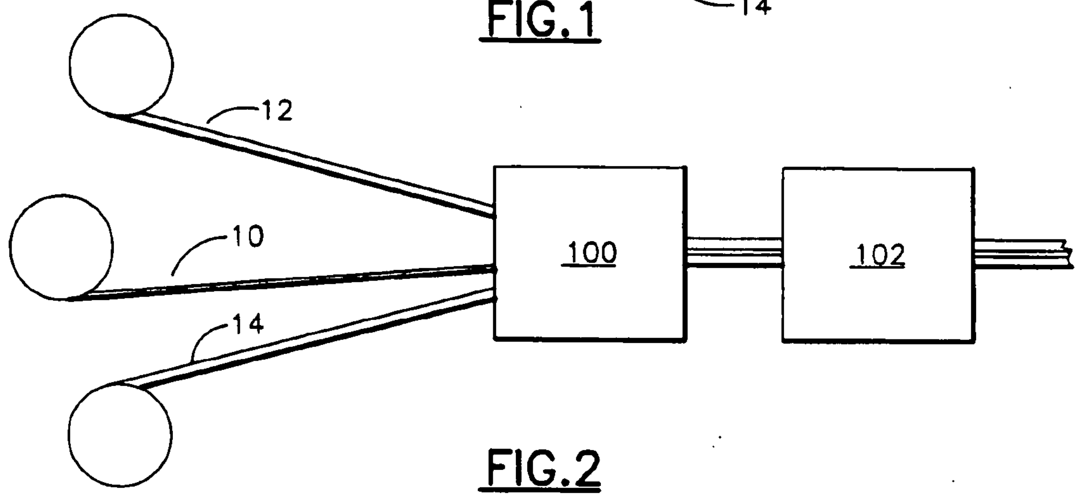

FIG.2

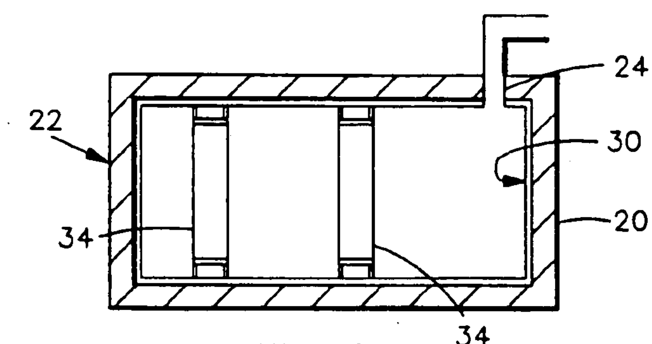

FIG.3

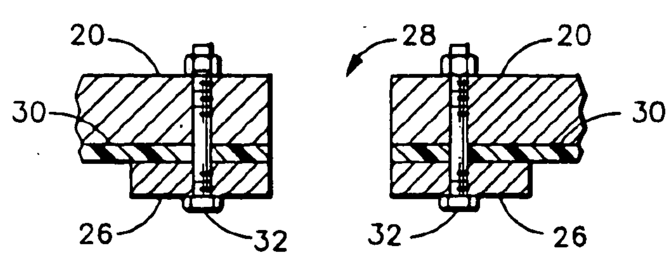

FIG.4

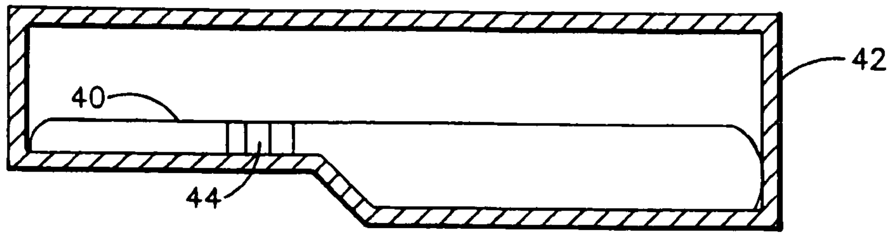

FIG.5A

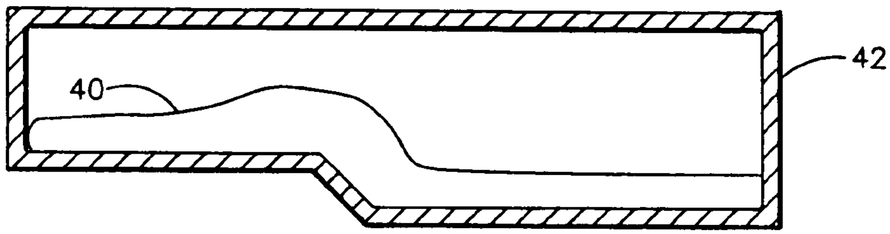

FIG.5B

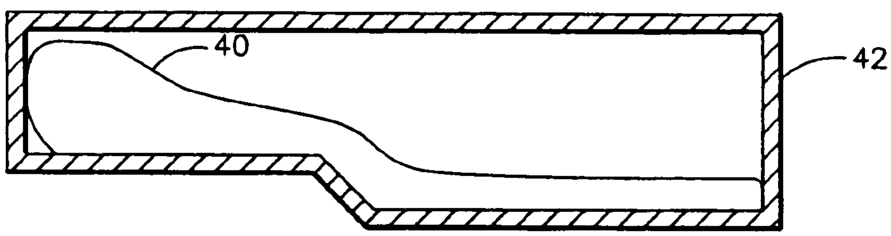

FIG.5C

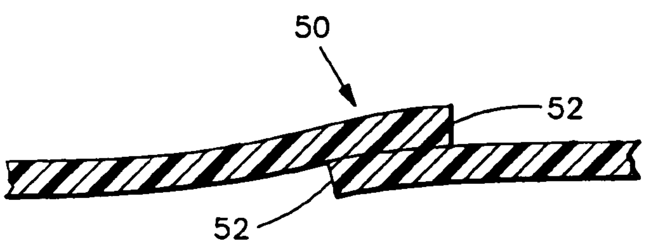

FIG.6

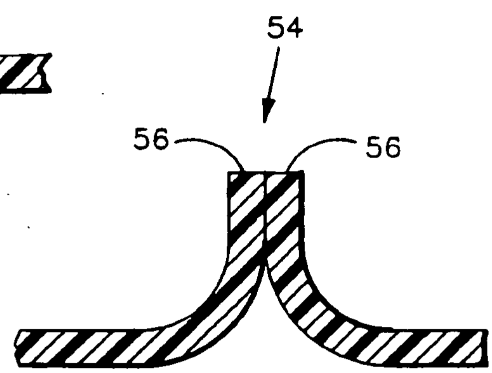

FIG.7

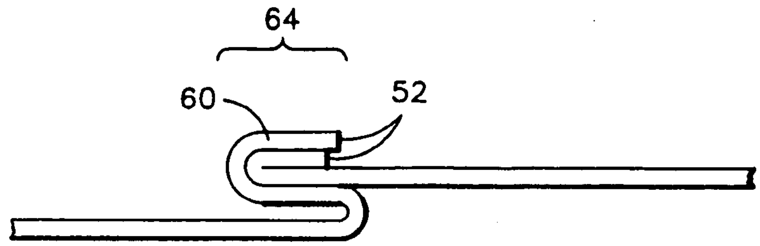

FIG.8

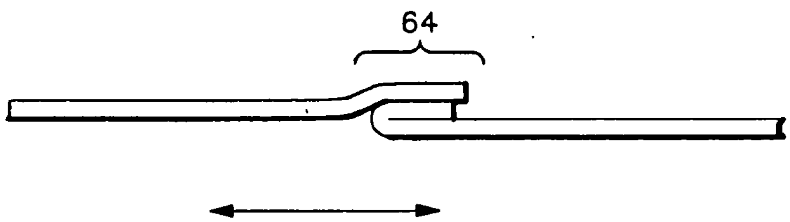

FIG.9

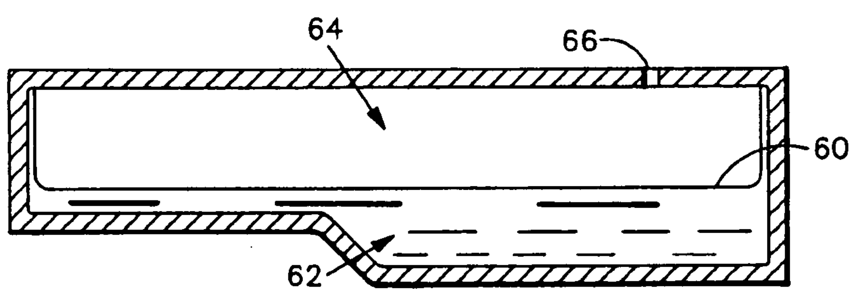

FIG.10

PATENT ABSTRACTS OF JAPAN

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(30)Priority

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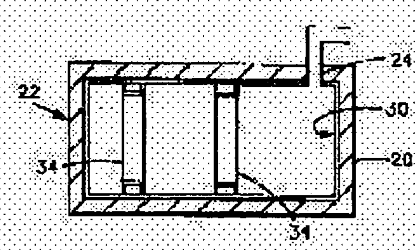
(54) FLUID STORAGE TANK AND LINER

(57)Abstract:

PURPOSE: To improve a fluid storage tank, especially, a flexible liner for the fluid storage tank.

CONSTITUTION: A fluid storage system containing an outer shell 20 and the flexible joined liner 30 provided in the outer shell 20 is provided. The liner 30 has a size larger than that of the outer shell 20 and, therefore, the stress or tensile force applied to the liner joint is reduced. An especially useful linear material is a gas sealed metal foil laminated to at least one fluoropolymer clad polyimide film.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

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[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

Machine translation of 06-064094 claims

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] The product which is a multiplex layer lamination product which has the endurance over osmosis which improved, and is characterized by changing including the gas sealing metal foil 10 of at least one sheet by which the laminating is carried out to the fluoropolymers clad polyimide film (12 14) of at least one sheet.
[Claim 2] The multiplex layer lamination product according to claim 1 which is inserted while said metal foil 10 is the polymer film (12 14) of at least two sheets, and is laminated, and is characterized by at least one side of this polymer film changing including a fluoropolymers clad polyimide film.
[Claim 3] Said fluoropolymers clad polyimide film (12 14) In the layer of polyimide, and a list, (1) PTFE, thermal compatibility TFE copolymers and those combination, or combination object;(2) PVF2, Thermal compatibility VF2 Copolymers and those combination, or combination object;(3) PCTFE, Thermal compatibility CTFE copolymers and those combination, combination object;, or (4) PTFE, Thermal compatibility TFE copolymers and those combination or a combination object, and PVF2, Thermal compatibility VF2 Copolymers and those combination, or a combination object, The multiplex layer lamination product according to claim 1 characterized by changing including 1 or the layer of two or more sheets of fluoropolymers chosen from PCTFE, thermal compatibility CTFE copolymers and those combination, or a combination object.
[Claim 4] Said metal foil is the multiplex layer lamination product according to claim 1 with which it is characterized by aluminum, copper, tin, lead, corrosion-resistant alloy steel, and said metal foil having the thickness of 0.00254-0.0038cm preferably 0.0013-0.0076cm here by being preferably chosen out of stainless steel.
[Claim 5] It changes including a multiplex layer lamination product according to claim 1 and the fluoropolymers film of at least one sheet currently thermally welded to this multiplex layer film. This fluoropolymers film changes including PTFE and the fluoropolymers thermally chosen from a conformable TFE copolymer and its combination, or a compound. And the multiplex layer lamination structure characterized by changing including PTFE which at least one sheet of the outermost surface of this fluoropolymers layer is not fusing here.
[Claim 6] The multiplex layer lamination product according to claim 1 further characterized by including the carbon particle which is the **** ingredient incorporated in 1 or two or more glue lines, metal particles, or those mixture.
[Claim 7] The fluid storage system characterized by making small the flexible stress or the tension which changes including an outer shell 42 and is located in said outer shell, and which joins together, and said liner serves as excessive size compared with said outer shell including a liner 40, and is applied to the liner joint 64.
[Claim 8] It joins together and the liner is included. at least two to which said liner is size excessive 3 to 15%, and one side is settled by said liner into another side -- Join together and the direction of the outside of a liner 40 changes including a foil lamination. these two -- And the fluid storage system according to claim 7 characterized by changing including a mesh for said outer shell 42 supporting hard,

a half-hard outer shell, or this liner here or other coupling means with opening.
[Claim 9] The fluid storage system according to claim 8 characterized by said outer shell containing 1 or two or more openings 24 for enabling receipts and payments of the flow of air in said outer shell.
[Claim 10] Change including a fluid sealing outer shell, and occupy the headroom of a tank, and so prevent evaporation of the fluid contents to the inside of a tank headroom. The flexibility barrier 60 located above the storage tank contents 62 is included. It is held in the location where said barrier touches the head of this outer shell, and said barrier has the quality of the material which becomes hanging down under gravity according to the change in the capacity of a content liquid enough. and (a) -- this barrier fluctuates by liquid contents -- alike -- following -- the upper outer shell of this barrier -- or (b) -- the fluid storage system characterized by including the ventilation means 66 which enables receipts and payments of the flow of the air in said barrier.
[Claim 11] The approach characterized by being the approach of attaching a liner into a storage tank, making the liner which has an excessive gestalt and size compared with this tank, introducing this liner subsequently to in this tank, and developing.
[Claim 12] The approach according to claim 11 characterized by including the phase of making the wall of said outer shell maintaining said liner by the hoop or stay.
[Claim 13] The splice characterized by being a splice for connecting the tip of a flexible ingredient, turning up a connection edge in the lap field 64, and locating the tip 52 of this ingredient in the whole surface of this splice by this.
[Claim 14] Said ingredient changes including a melting nature ingredient, and this can be thermally laminated by itself in this lap field by this. And said ingredient preferably here [whether it changes including a polymer film and the gas sealing metal foil which carried out the laminating to the fluoropolymers clad polyimide film, and] Said ingredient Or a vinylidene-chloride content polymer, an urethane clad polymer film, The biaxial-stretching condensation film of polyethylene terephthalate and ethylene glycol, Biaxial-stretching condensation polymer; or a polyamide, polyimide, polyether imide, Polyethylenenaphthalate, poly BENJIMIDAZORU, polybenzoxazole, The splice according to claim 13 characterized by changing including the polymer film chosen from the copolymer and vinylidene chloride of polyethylene, polystyrene, ethylene, and vinyl alcohol.

[Translation done.]

Machine translation of specification of 06-064094

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the improvement in a fluid storage tank, and an improvement especially in the flexibility liner system for a fluid storage tank. Other applications are also considered, although this invention has a specific application about the fuel storage tank for an automobile, and relates it with this application and being described.
[0002]
[Description of the Prior Art] The liquid fuel for an internal combustion engine and heating changes including a purification hydrocarbon typically. This matter is high energy and it is inflammability, and if these begin to emit or fall, they may cause a serious environmental damage. The range of this matter may be carried out to the viscosity of ten to 1,000 centipoise, and it changes including a combination object with the chain compound which generally has about 54 low molecular weight, a specific additive, for example, the tetraethyl lead, and a phosphorus compound, volatile alcohol, and the ether, and this additive may exist [more than it] to a minute amount, a catalyst-amount, and 30% of the weight of a fuel. Alcohol is also used as a principal component of liquid fuel, and it thinks for the larger application.

[0003] The large application of volatile liquid fuel brings about the greater requirements for contamination and storage. Very much the range of these requirements that it may be adopted in purification or distillation from a millions of gallons big storage tank Pass the storage tank (10,000 - 50,000gal) of an in-between capacity in which it is adopted in a retail gasoline station and deals. for example, pass the smaller capacity tank (250 - 1,000gal) in which it is adopted in a family group's dwelling and deals -- it results even in an automobile and the small capacity tank (1 - 100gal) in which it is adopted as a list in the instrument of a farm and the yard, and deals. Generally these tanks are fabricated from steel or the product made from plastics, for example, glass fiber reinforcement-ized polyester, polyethylene, or nylon.
[0004] A metal tank and the tank made from plastics have a fault and an advantage, respectively. A metal tank is inactive and can make electrostatic charge dissipate in an attack for it to be relatively strong and according to a hydrocarbon. The metal tank is further comparatively cheap and it has the outstanding contamination property and the outstanding infiltration resistance. However, a metal tank may be attacked with a content liquid, or, in the case of an underground storage, it may be attacked by the soil component, this may cause rust or corrosion, and this may bring about damage on the microscopic or bigger scale of a tank wall. A metal tank is comparatively heavy and this [its] is disadvantageous for an automobile or the tank in other applications on board.
[0005] The tank made from plastics is lightweight, and is assembled by many techniques containing blow molding, rotational casting, and injection molding, and it deals in it. Plastics has the outstanding reinforcement, and each plastics can be chosen so that it may have the outstanding compatibility with each component (for example, nylon for a hydrocarbon and polyethylene for alcohol). However, although not impossible, it makes it difficult to use independent plastic material, without being

accompanied by the danger of an attack reach and according [/or a variety of fuels which are considered] to some fuel components by which current use is carried out. Furthermore, even if this plastics shows mechanical compatibility with that fuel inclusion, there may be a lot of transportation of the fuel molecule through this plastics wall.
[0006] This industry has advocated addition of carrying out alloying of fluorination of some techniques for making the infiltration resistance of the fuel tank made from plastics improve, for example, the surface of polyethylene, sulfonation of the surface of polyethylene, and the polyolefine to a barrier ingredient, for example, nylon, and mineral plate let, for example, a mica, and coincidence extrusion with the resin for a package, or coincidence blow molding. All of such technique show the significant fall of the permeability of a certain amount of fuel component. However, it does not pass over these to reduce the rate of osmosis, and they do not improve the chemical resistance of the base resin to a content liquid. Furthermore, there is a question about the capacity of these ingredients that bar osmosis of some chemical entities considered for the present fuel. Furthermore, there is a question about the long-term effectiveness of surface processing when barring osmosis.
[0007] This industry has advocated some techniques for improving the integrity of a fuel storage tank further. For example, it is carried out by the current general one that apply the independent stowage container which covers the second receipt means, for example, a double-integrity tank, or a tank to a new metal or the tank made from plastics, or this converts a current metal or the current tank made from plastics. On the other hand, the liner or bladder (tank) which changes from flexible plastics or a flexible elastic body to this tank may be given.
[0008] Other problems about a fuel tank are repetitive emission of the steam to atmospheric air whenever it is re-filled up with a tank. In the usual fuel tank, upper space serves as saturation from liquid fuel with the steam of a fuel. Therefore, when re-filled up with a tank, this saturated steam will be emitted to atmospheric air, unless it is emitted from a tank, therefore is caught in a steamy recovery system. Although various systems are developed for steamy recovery, troublesomely, this is heavy to coincidence and may need service frequently still at an expensive price. In the case of the fuel storage tank of a comparatively small capacity adopted in an automobile, a farm, a yard instrument, etc. which need restoration frequently, the problem of emission of the steam to atmospheric air is especially important. As what is replaced with a steamy recovery system in ordinary use, it is the flexibility liner or bladder containing a liquid, and is fully flexibility to the form of a liquid, and is compatibility, therefore small or reducing free steamy space are proposed inside this bladder in the hard fuel tank in ordinary use by giving that a ****** steam or whose headroom (overhead tooth space) is lost. This liner or bladder is contained inside a hard liquid sealing tank, and is supported by this tank.
[0009] By choosing the liner or bladder which has sufficient infiltration resistance over the molecule of a content liquid, it is because the liner which can prevent osmosis and evaporation of the fuel to the headroom in a hard tank, because contains liquid fuel suits the gestalt or capacity of a content liquid. It will prevent fuel vapor's moving this liner to a headroom by a headroom still existing in a hard tank, although it becomes large as a fuel is consumed, and being filled with it. Therefore, probably, this headroom is constituted by atmospheric air nearly completely [this] as a matter of fact, excluding an osmosis fuel molecule. When filled up with a tank, a liquid expands in this liner entering direct and here, and suits a hard tank. Furthermore, only air is eliminated from the headroom of this hard tank. Therefore, probably, emission of the fuel vapor to atmospheric air does not have ******.
[0010] The tank shipping agent on the street has also adopted the flexibility tank liner, in order to increase profits. For example, according to the report, a certain tank shipping agents are two flexibility liners at the tanker, one liner is designed for the use at the time of transporting a lubricating oil to a certain destination, and the thing designed for the use at the time of the liner of another side transporting orange juice to another destination is made to equip.
[0011] The flexibility tank liner or bladder ingredient by which current marketing is carried out shows comparatively high permeability to a light hydrocarbon, for example, a high purification gasoline, and a gasoline additive, for example, alcohol, especially. Furthermore, the liner or bladder made from the flexibility tank liner or the bladder ingredient, and them which can come to hand now has the limited

combustion intensity, and has a weak thing especially at the assembled joint. It is because this offers a problem, because the fuel tank of an automobile can receive extreme mechanical pressure in case liquid fuel rebounds as a result of sudden moderation or the situation of especially a collision. Furthermore, it may also bring destructive loss of fuel contents that it does not have a tank liner that a hard tank outer shell receives damage by collision for a certain reason, and so it spoils an environment, and raises **** of a fire or explosion.

[0012] Over the service life of the tank equipped with it, maintaining mechanical integrity and reinforcement must be continued in a flexibility list, and a tank liner or a bladder must offer an indispensable barrier and a chemical adaptation property. The tank liner should have further sufficient heat permissible capacity which remains on manufacture conditions and a service condition, without being accompanied by loss of a barrier property or a mechanical strength. For example, as for ambient temperature becoming low in a northern district from 50 below the freezing point-60 degrees F, or it considerably, in the case of a motor fuel tank, ambient temperature may amount to 130 degrees F or more in the fixed desert district in the world rarely. Furthermore, also in a temperate district, the temperature of the automobile in near a fuel tank may amount to 200 degrees F or more.

[0013]

[Problem(s) to be Solved by the Invention] Therefore, the purpose of this invention is in the liquid fuel tankage system distribution which solves the above and other faults of the conventional technique. Other purposes of this invention are in offer of the design and the manufacture approach at the liquid fuel liner ingredient list which is suitable for especially the use in storage of a liquefied hydrocarbon fuel etc., and is characterize by capacity [endurance / operation / osmosis of a liquefied hydrocarbon fuel and fuel additive, alcohol, the ether, etc., and / both / harmful] at mechanical integrity and reinforcement, and a list.

[0014]

[Means for Solving the Problem] This invention followed like 1 voice and we found out that the fixed fluoropolymers clad currently indicated to 717,855 the 07th/of our coincidence connection United States patent application was employable as a flexibility liner or barrier ingredients, such as a fuel tank. this invention -- being the further -- others -- and desirable voice -- it sets like, and the gas sealing metal foil of at least one sheet may be inserted between a fluoropolymers clad polyimide film or other polymer films, and may carry out a laminating.

[0015] Further another viewpoint of this invention offers the manufacture approach of the multiplex layer structure object which changes including 1, the fluoropolymers clad polyimide film of two or more sheets and 1, or the metal foil of two or more sheets welded mutually thermally. this invention -- the -- being the further -- others -- a viewpoint -- setting -- the description and advantage of an exfoliation mold joint -- an association -- although it is, the peculiar joint or peculiar splice which is continuing holding ultimate **** and breaking strength of a shearing-die joint is offered. the last -- this invention -- being the further -- others -- a viewpoint offers the storage tank collection object containing the larger flexibility liner or larger bladder currently designed so that it may protect to an external hard tank outer shell and combustion.

[0016] We found out that the fluoropolymers clad polyimide film currently indicated in our coincidence connection United States patent application 07th / No. 717,855 could be advantageously used as the flexibility barrier in a fuel tank, or a bladder ingredient. A multiplex layer film is made in more detail by combining 1 or two or more layers of the thermal weldability fluoropolymers film chosen from the group which consists of those combination or compounds of PTFE (polytetrafluoroethylene), the homopolymer of tetrafluoroethylene (TFE monomer), a thermal compatibility TFE copolymer, and arbitration in the layer of polyimide as the above-mentioned coincidence connection U.S. application 07th included in this specification as reference / instruction of No. 717,855. TFE used for this specification -- a copolymer -- as for a word, a copolymer with the ethylene system partial saturation monomer of TFE and others, for example, copolymer [with HFP (hexafluoropropylene)] (known as FEP [fluorinated ethylene propylene]);, copolymer [with ethylene] (known as ETFE);, copolymer [with a propylene] (known as "Aflas");, perfluoroalkyl vinyl ether (MFA), for example,

perfluoromethylvinylether, or perfluoro propyl vinyl ether (PFA) is contained. These fluoropolymers (two or more sheets) are PVF2 or (poly vinylidene fluoride) PVDF (homopolymer of a vinylidene fluoride (VF2) monomer), and the thermal compatibility VF2 further. You may also choose out of the group which consists of those compounds or combination of a copolymer (copolymer with the ethylene system partial saturation monomer of a vinylidene fluoride (VF2) and others, for example, CTFE, (chlorotrifluoroethylene), and HFP), and arbitration. the "copolymer" which is suitable in this specification -- HFP and VF2 as a comonomer with TFE [in / in a word / 1 or two or more sorts of ethylene system partial saturation comonomers (TFE terpolymer), for example, a polymer,] Both adoption is included.

[0017] In our above-mentioned coincidence connection U.S. application 07th / No. 717,855 as instruction a fluoropolymers clad polyimide multiplex layer structure object On a polyimide content film, PTFE, A thermal compatibility TFE copolymer And the ingredient chosen from the group which consists of those compounds Contain and the glue line which changes ; which carries out the coat of the fluoropolymers film to the glue line on one [at least] field of; polyimide content film which carries out a coat --; which applies the second fluoropolymers film to the glue line on one [at least] field of this polyimide content film -- these layers subsequently It is manufactured by making it weld thermally and making the structure form. Although PTFE is independently employable like a glue line ingredient, it is because using the combination of PTFE and a thermal compatibility TFE copolymer needs the working temperature which it is wanted more, because the use by the PTFE independent may bring degradation of the reinforcement of polyimide or polyimide / fluoropolymers interface in order to produce and cheat out of this association on the standpoint of processing. It means that the fusion compound of the polymer which has the physical property which should use the thermal compatibility TFE copolymer, and this could process these copolymers together with PTFE, therefore was excellent can be offered. Both these processing approaches are described by the coincidence connection U.S. application 07th by which inheritance was carried out to the common grantee included in this specification as reference / No. 305,748, and U.S. Pat. No. 4,883,716. Especially a useful thing is a polyimide film currently indicated in U.S. Pat. No. 3,616,177 which included the contents of an indication in this specification as a polyimide film for the use in this invention. In a polyimide layer, other polyimide films (trademark), for example, Apical, or Upilex(es) (trademark) can be used for Kapton(trademark) H and Kapton (trademark) HN, and a list. The layer of this polyimide film is 0.7 - 1.3mil in about 0.5 to 2.0 mil, and a twist type target typically. It should have thickness.

[0018] PTFE used in this invention should have preferably at least 1010P of 1010-1012P melt viscosity at molecular weight and typical comparatively high 380 degrees C. PTFE used in this invention may originate in the aquosity dispersing element of an ingredient like full ORON (trademark) 81 and Algoflon (trademark)60 at Teflon (trademark)30, AD (trademark)1, and a list. PTFE may make the glue line of this structure form combining a thermal compatibility TFE copolymer, for example, FEP and PFA, or MFA. When using FEP, this is 3x104 -2.5-105 typically at the melting point of about 268 degrees C, and 372 degrees C. It should have the melt viscosity of the range of a poise. FEP may originate in the aquosity dispersing element of an ingredient like Teflon(trademark) 120, Teflon (trademark) TE9503, and Teflon(trademark) TE5582.

[0019] When using PFA in the glue line of this invention, this is 3x104 to 2.5x103 at the melting point of 305 degrees C, and 372 degrees C typically. It should have the melt viscosity of the range of a poise. PFA may originate in the aquosity dispersing element of an ingredient like Teflon(trademark)322J. This glue line is applied by any of coating or a laminating technique they are, and it deals in it. Typically, this layer is formed of water nature powder coating.

[0020] Generally this glue line should be a TFE copolymer with the thermally conformable remainder at least, including PTFE of 40 capacity %. The useful presentation for a glue line is the thermal compatibility TFE copolymer of PTFE of 50 capacity %, and 50 capacity %. temperature with the expensive structure obtained -- the formation of a delamination -- receiving -- resistance -- it is -- and flexibility -- and having been tough was admited. These properties become together with the outstanding resistance over osmosis by almost all the hydrocarbons fuel, and make our copending application 07th /

fluoropolymers clad polyimide film of No. 717,855 the liner in the fuel tank about this invention, or what is useful as a bladder. However, although the clad contains the fluoropolymers clad polymer film of other marketing even if only in 40% or less of PTFE, it can adopt directly advantageously, without being accompanied by the further clad, or according to the above-mentioned, a clad may be carried out further. In the fluoropolymers clad film of suitable marketing, it is Apical from applied APIKARU. AF, especially Apical AF919, Kapton which can come to hand from Du Pont F, especially Kapton F919, Upilex from U.S. ICI C, especially Upilex C 25RCB05F and Chemfilm(trademark) DF from KEMUFABU, Inc. 2919, especially Chemfilm D2919-2.0mil It is contained.

[0021] In other modes of this invention The thin metal foil, for example, 0.0005-0.003 inches (0.00127-0.00762cm) metal foil, For example, steel made from aluminum, copper, tin, lead, or stainless steel or other foil made from ******-proof steel, desirable -- aluminum or copper -- most preferably aluminum between the layers of a fluoropolymers clad polyimide film or others -- it inserts comparatively between the layers of the rate of high elasticity or a "rigid" polymer film, for example, polyethylene terephthalate, and the biaxial-stretching condensation polymer film of ethylene glycol (PET). The PET film is marketed from much origins and contains Mylar from E. I. du Pont de Nemours, and Malinex from U.S. ICI. Furthermore, if it wants, the clad of the PET film will be carried out by poly vinylidene chloride, urethane, or the other charges of clad material, and it will deal in it. Biaxial-stretching polyolefine (for example, polyethylene or polypropylene) is contained in a biaxial-stretching polyamide (nylon), non-fluoropolymers clad polyimide, the polyether imide that can come to hand as Kemid from Norton, the biaxial-stretching polyethylenenaphthalate (PEN) which can come to hand from an ICI film, poly BENJIMIDAZORU (PBO) and the polybenzoxazole which can come to hand from the Dow Chemical, and a list at the film of others which can be used instead of a PET film. In order to raise the barrier property, the clad of this ingredient may be carried out with poly vinylidene chloride (PVDC), thin glass, etc., or it may be plated. The copolymer (EVAL) of polystyrene, a polyamide, ethylene, and vinyl alcohol and poly vinylidene chloride are contained in the other polymer film materials in which it is used in favor of this invention, and deals. In such a case, it sets, the copolymer of ethylene and vinyl acetate, the copolymer of ethylene and a maleic anhydride, acrylic, an urethane system, an acrylic-urethane system, and an "ionomer" ingredient are contained in the adhesives used for combining the layer of plastic material with the metal foil, and it gets. Preforming of the polymer film layer is carried out, or on the metal foil, it is fabricated on the direct spot and deals in it. On the other hand, a plastic film layer can be preformed and the metal foil can be made to fabricate on that spot by subsequently to this polymer film top making a metal vapor-deposit.

[0022] The lamination which consists of the metal foil inserted between the PTE films of two sheets is made by carrying out the coat of the adhesives with high endurance to this film chemically, and subsequently to the metal foil carrying out the laminating of it on a hot laminator. Use polyester resin as the base, for example, these adhesives are Adcote. 1217 The Morton International or Adcote 506-40 Morton In order that it can be international and this may raise that chemical durability and the bond strength of a lamination, the bridge is made to construct by isocyanate. The isocyanate used in this processing is TDI (for example, Catalyst F, Morton international) or MDI (PADI 2027 and the Dow Chemical Co.), and it deals in it. According to the system, the ratios of resin/isocyanate are 100 / 2 - 100/8, and it deals in them. The coating weight of adhesion mixture should be 3-4Lbs/3000ft2 (4.8824-6.5099g/m2). A lamination product takes five to 8th day at a room temperature until it hardens it completely.

[0023] This lamination can be joined together using the same adhesives as lamination, or other suitable adhesives. Typically, the coat of the joint is carried out, and it pushes mutually, and these adhesives are stiffened partially at least. For example, in order to join together by Adcote, this coat-ized joint is dried and, subsequently it pushes mutually at 180 degrees - 250 degrees F (82-121 degrees C) (Adcote 506-40) or 275-300 degrees F (135-149 degrees C) (Adcote 1217). Next, this joint is cooled under pressurization and it is demounted from this press. It needs for perfect hardening of this joint for five - eight days at a room temperature.

[0024] On the other hand, PET (for example, Melinex 301H, an ICI film) which has a heat seal nature

surface can be used. In this case, a joint can be made with a standard heating sealing technique (for example, based on 285-295 degrees F (141-146 degrees C), 40psi (275.8 dynes/cm2), bar sealing in 1 second or the nozzle temperature of 200-250 degrees C, and the hot blast sealer in speed 3-6fpm). Other adhesives can also be used under the setups.

[0025] 0.00025 inches - 0.003 inches (0.0066-0.0076cm) of 0.0005 inches - 0.0012 inches (0.0013-0.0030cm) of thickness of a PET film should be 0.0005 inches (0.0013cm) most typically. The defense nature of this film to formation of the pinhole at the time of making it crooked becomes better, so that the gage of this film becomes thin over 0.0005-0.002 inches (0.0013cm - 0.0051cm).

[0026] The metal foil is well known about the resistance over osmosis. Therefore, the nest of the thin metal film or foil in a lamination product can prevent osmosis of the fixed component of the hydrocarbon fuel compound which may permeate a polymer film layer, if there is no it. This polymer film layer may protect this metal foil from corrosion or embrittlement by preventing direct liquid contact for many fuel components.

[0027] By the way, generally aluminum thin enough or other metal foil (0.0005-0.003 inches) (0.0013-0.0076cm) tend [very] to receive damage and pinhole formation based on light crookedness, bending, or extension to the extent that it thinks that it is flexible. We found out it being improved substantially and dealing in the resistance over pinhole formation by this invention's following like 1 voice and carrying out the laminating of the foil between fluoropolymers clad polyimide films. Furthermore, repetitive crookedness of a lamination product and having been further obtained in spite of extension were admitted for the endurance over pinhole formation. Although it does not desire to be restrained by the theory, fluoropolymers adhesives produce and cheat out of crevice bond between the foil and a polyimide film layer, and, thereby, the mechanical demand of crookedness and extension is moved to the direction of the layer of the polyimide film which supports and stabilizes the layer of this foil in part at least. Even if some pinholes are formed in this metal foil layer, the integrity which becomes that a fluoropolymers clad polyimide film element blocks or lowers at least osmosis through all the pinholes in which it is formed in this foil layer and deals enough is held.

[0028] If it wants, a **** ingredient, for example, a carbon particle, or metal particles can be included in this glue line, and the ingredient obtained can also be made into dissipation nature electrostatic. Typically, although it is not indispensable, this **** ingredient will be ****(ed) in the lamination element nearest to a liquid. Furthermore, typically, these will be put in order so that the whole liner may be grounded, single touch-down of a liner may be enabled and this ****** in a liner may become continuous, although it is not indispensable.

[0029] Although reference is made about drawing 1 from this, the desirable gestalt of the flexibility liner lamination film product made according to this invention is illustrated there. the voice of this invention with this desirable film -- set like, and the 0.002 inches (0.0051cm) fluoropolymers clad polyimide film layers 12 and 14 be alike, respectively, and be caught -- and it changes including the 0.0003-0.005 inches (0.0008-0.0013cm) aluminium foil layer 10 which carried out the laminating.

[0030] Typically, although it is not indispensable, the fluoropolymers clad polyimide film layers 12 and 14 may change including the same fluoropolymers clad polyimide ingredient, and may be thickness which is the same and different according to the purpose of use. Typically the aluminium foil layer 10 0.0005-0.003 inches (0.0013-0.0076cm), It can be the thickness of the range of 0.001-0.0015 inches (0.00254-0.0038cm) more typically. The fluoropolymers clad polyimide film layers 12 and 14 should be at least 0.0005 inches (0.0013cm) in thickness in that case. Typically 0.0015-0.005 inches (0.0038-0.0127cm), Probably, it has most typically 0.00125-0.003 inches (0.0032-0.0076cm) of thickness of 0.0015-0.0025 inches (0.00254-0.0064cm).

[0031] Although reference is made about drawing 2 from this The undercoat which uses fluoropolymers as the base first at :aluminium foil layer 10 from which this lamination product is made as follows (For example, with the ingredient described by U.S. Pat. No. 4,770,927 of Effenberger included in an FE independent, the compound of fluoropolymers, or this specification as reference, and Keese) Or the special primer designed so that PTFE may be pasted up on aluminum, The undercoat of the 0.00025-0.0005 inches (0.00065-0.0013cm) is carried out typically the quotient lot number number 858-150 and

0.0001-0.001 inches (0.000254-0.00254cm) of films by Du Pont. Since outstanding association of as opposed to this glue line for the compound of the topcoat which uses the further fluoropolymers as the base, for example, fluoropolymers, PTFE, and the fluoro elastomer (namely, latex TN-Aussie MONTO (Ausimont)) described by U.S. Pat. No. 4,730,927 of the above-mentioned J.A.Effenberber and F.M.Keese is secured, you may apply in the same way.

[0032] The coat of the polyimide film layers 12 and 14 is carried out by the same approach by the aquosity dispersing element of fluoropolymers, for example, PTFE, PFA, FEP, and MFA, mixture, or a compound. These layers of each other that carried out the coat are laminated by hot lamination, pinching an aluminum layer among them.

[0033] The coat of the polyimide film layers 12 and 14 is first carried out to the aluminium foil layer 10 and a list in a coating station 100 by the aquosity dispersing element of fluoropolymers, for example, PTFE, PFA(s), FEP, and MFAs, those mixture, or a compound, respectively. these coatings -- DIP coating in ordinary use -- it is applied in a column, and the layer of each other by which the coat was carried out is laminated, being a hot lamination and pinching this aluminium foil layer between polyimide film layers at the lamination station 102.

[0034] According to the following, it applied to the Gelbo bending test, using the Gelbo circuit tester of improved marketing which can obtain the multiplex layer fluoropolymers clad polyimide film product obtained from U.S. Testing, a HOBOKEN city, and New Jersey. A Gelbo trial is ASTM. It is similar to F392-74 (the standard examining method about the bending resistance of a flexibility barrier ingredient) with it of description.

[0035] :full crookedness whose test condition is as follows -- two-cycle speed: -- a part [0036] for 60 cycle/ A 8.0 inch x11.5 inch (20.32x29.21cm) sample is formed in a cylinder with a height of 8.0 inches (20.32cm), and it attaches on equipment and in the bottom. In order to produce and cheat out of bending, the top face of a cylinder was made to **** quickly and it moved towards this cylinder base by rotation exceeding 360 degrees. This brings about that this ingredient is twisted to a rope Mr. gestalt. Next, it is loosened and made straight so that this equipment may be returned and this sample may return to a cylinder gestalt. This cycle is defined as 1 "crookedness" of a sample. By ****(ing) this sample on light BOKKU, all pinhole breakage of this metal foil can be recognized. When micro management of this metal foil is carried out with the polyimide mentioned above, even if it makes this structure repeatedly crooked in a Gelbo trial, it is endurance at pinhole formation. This test result was equal to two crookedness, without accompanying this structure by pinhole formation, and suggested that it could be equal to the further crookedness with only slight pinhole formation. This result was farther [than other approaches of arbitration "protect" a metal barrier] excellent.

[0037] It sets to another trial and is 0.5mil to each field. 1mil which has fluoropolymers It is 1.3mil about a polyimide clad. It laminated to both sides of undercoat-ized aluminium foil. Some samples of this ingredient were examined in the Gelbo bending circuit tester, and the relation of the following [between the number of pinholes accepted in the count and this sample of crookedness] was accepted.

屈曲の回数	ピンホールの数
0	0
2	0
5	1
1 5	1 0
2 5	1 5*

* Five comparatively big pinholes (1mm of ****) were included.

[0038] The Gelbo bending test of polyester / foil structure is :gage (inch) in which it was shown that the number of pinholes decreases as thickness of the polyester film to be used was made small. Several 0.003 of the pinhole after two crookedness 80.002 40.001 20.0005 1 [0039] As further index of the integrity of micro management of the foil by the fluoropolymers clad polyimide film product, (Said clad polyimide is combined with each side of this foil) The Instron **** sample which received the

becoming extension (30% - 50%) whether it is accompanied by contraction of 20% of width of face When [of the fracture point] the indication of a delamination ****(ed) on ****** private seal **** and transilluminator immediately in addition to a side, it was shown that there is no pinhole formation ****** private seal ** as a matter of fact.

[0040] The ingredient was cut and fabricated about drawing 3 in a gestalt which suits substantially the gestalt and size of hard or the half-hard tank outer shell 20, and it has joined together using hot SHIMA. On the other hand, an outer shell 20 can change including the outer shell made from a rigid plastic which has a mesh for supporting a bleeder for air escaping or this liner, or other coupling means. When the fabricated product is installed into hard or a half-hard tank outer shell and begins to be rolled typically, and when it fills up with a tank, all stress or tension are not applied to this joint. Rather, it will be cutting, shaping, and joining together about this ingredient so that this ingredient may become a little large 3 to 15% according to the factor of size and others like arrangement, for example, as the outer shell of this tank is started. Next, a liner or a bladder 30 is inserted into folding and the current tank 20, and it fixes to this tank in the restoration field 24 of a tank 22.

[0041] Furthermore, CHEMGLAS (trademark) pre MIUMU 5mil which can come to hand from KEMUFABU (Chemfab), concerning drawing 4 The heat lamination of the color 26 for reinforcement with opening formed from the 0.005 inches (0.0127cm) fluoropolymers clad glass base ingredient [like] is carried out around the inlet-port hole 28 of a liner 30, subsequently to a tank, bolting of this liner is carried out, or it is concluded in a location 32. About a location fixed storage tank like underground or an above-ground storage tank, it sets in that location by the support hoop or stay 34 grade, is supported and fixed, and deals in this liner or bladder 30. Therefore, in new tank structure, a liner 30 is adopted in reconstruction of an existing tank, and it deals in it.

[0042] Since it is adapted for a sudden surprise attack of the fuel in the rapid moderation which this liner or bladder 40 is typically made greatly enough about drawing 5 A - 5C compared with the size of hard or the half-hard tank 42 in installation of the liner to tanks, such as an automobile, and results, for example from a collision by this, rapid expansion or expansion of this liner is possible. It is bundled, or it is a letter of a pleat in the location 44, without following, being able to make the liner 40 excessively 10 to 15%, and pressing this liner too much so that it may become the expansion with this rapid liner, and expandable. Since this liner 40 is quite thin, the bundled ingredient does not make capacity of this tank small intentionally.

[0043] Repetitive crookedness of a foil clad lamination does damage to the foil, and carries out pinhole formation as mentioned above. Therefore, when tanks, such as an automobile on the street, are covered over restoration of 100 numbers and get over the life of an automobile, it is desirable to use the non foil lamination product made from the charge of plastics lumber chosen as the target fuel contents as a resistance thing. Use of a non foil lamination product should be made to essentially lose, and it makes it essentially lose or it lessens substantially volatile matter in the steamy capacity on an oil level by 100% of un-permeating to all liquid fuel volatile matter, although there is probably nothing or it so lessens the leakage of the volatile matter under restoration substantially.

[0044] The shearing-die joint 50 (drawing 6) offers the strongest joint in **** and breaking strength as you may set in this industry and it is known. However, it is because exposure to the fuel at the tip 52 of a lamination from which it does not ask for a shearing-die joint in formation of a fuel tank liner or a bladder, because the shearing-die joint is not protected will be enabled. Exposure at the tip which is not protected can cause **** of degradation and/of/or a lamination, or the metal foil at the list which carries out possible [of the migration or osmosis through a lamination in this exposure-ized tip 52 of a liquid]. The exfoliation mold joint 54 (drawing 7) of; which prevents exposing the tip 56 of a lamination to a fuel, however an exfoliation mold joint is comparatively weak in **** and breaking strength. Although an exfoliation mold joint is adopted in the case of a location fixed fuel tank and got, the exfoliation mold joint does not have the reinforcement of the like adopted when making the tank liner or bladder for an automobile which becomes enough.

[0045] Therefore, according to other viewpoints of this invention, we proposed further the combination (however, it does not have fault of these very thing) exfoliation / shearing-die joint which combined the

advantage of an exfoliation mold and a shearing-die joint. It is fabricating especially about drawing 8 by turning up the tip of a lamination for the combination exfoliation / shearing-die joint, or the splice about this invention on itself, and lapping for example, by heat sealing and carrying out the seal of this folding in a field 64. So, the joint obtained provides flat-surface contact like [in the case of an exfoliation mold joint], and a list with ultimate **** and breaking strength of a shearing die. Therefore, when a joint receives the pressure of an attack of for example, a content liquid as shown in drawing 9 , this joint continues bearing until it reaches that joint reinforcement. Subsequently the exfoliation field of this joint separates, if it puts in another way, the energy of a constant rate will be released, and capacity of a liner or a bladder is enabled to increase. Therefore, the pressure to the ultimate strength can be put on the shear part of this joint, and, so, the further remaining power of insurance is offered.

[0046] About drawing 10 , as the flexibility overhead location air bag or barrier 60 located on the fuel tank liquid contents 62, the charge of a polymer laminate material made according to this invention occupies the headroom 64 of a tank, so, in order to prevent evaporation of the fuel vapor to the headroom 64 of a tank, is used advantageously and deals in it. In order to enable receipts and payments of the flow of the air of this overhead location barrier as this barrier fluctuates on this tank according to the fuel inclusion 62 in this case, the aeration means 66 should be as **. The barrier (bag) 60 is located in the upper part of a tank. And this barrier It makes it possible to hang down, or to carry out capacity change as a function of differential pressure produced by discharge of a fuel, or to carry out capacity change as a function of change of ambient temperature under gravity, as the oil level of a fuel falls. Make contact to liquid fuel essentially maintain, and the fuel vapor of arbitration makes a headroom form, and it has enough special ingredients which prevent being able to escape to the open air subsequently.

[0047] Although it related with the desirable mode in the tank liner for a fuel tank, or offer of a bladder and this invention has been described, it will also be understood that this invention can be advantageously used for the container of aquosity and nonaqueous nature chemistry. Furthermore, a various polymer ingredient and various adhesives are adopted for two or more layers, and it gets. For example, aluminium foil can also be laminated between a polyester external film layer and the interior film layer of polyimide. Furthermore, it can change including that the tank liner made according to this invention is the same, or two or more independent bags which consist of a different charge of a laminate material and with which one side is contained in another side. For example, for the use as a fuel tank liner, an internal liner may change including the lamination of the fluoropolymers clad polyimide which is impermeability to the hydrocarbon component of a fuel, and an external liner can change including the lamination of PET which is impermeability and which carried out the laminating to the foil to alcohol in that case. Although the hole of the inlet port of that correspondence adjoins so that this interior and the external liner of each other may be fixed by lamination or the machine target and a common inlet port may be formed, it is desirable and free to each other.

[0048] An infiltration-resistant bladder includes two fundamentally different applications, and this invention described here includes this way in two ways as described above.

[0049] The group of one application includes the count of restoration exceeding 100-2000, and needs to lessen loss of a fuel molecule in the case of both check and restoration. These applications are flexibility and need the ingredient which suits the gestalt of a content fuel. Probably, the application of the fuel container for ways mainly belongs to this group. These applications can use the lamination structure which generally does not contain the foil.

[0050] The classification of other applications includes many counts of restoration, and requires the zero or the very low permeability over the fuel molecule of far-reaching versatility. Probably, the storage tank which probably needs a very long life and/or very low permeability, or other tanks usually belong to this group. This application should usually be made advantageous by foil lamination. By containing the metal foil in this bladder, these applications can use the technique of stay or others, in order to hold the bladder which generally spreads. This technique means being generated only in case bending of a bladder is anchoring, therefore restricting the count of bending.

[0051] Although some applications can require the permeability of the very low level given with the

foil, the flexibility of the high level offered according to non foil structure is also required. Other elements of this invention are the "bag Inn bag" concepts surrounding an internal bag (the foil is not included preferably) with an infiltration-resistant very flexible high external bag (the foil is included preferably). This external bag is contained inside this tank, or is carrying out the exaggerated pack so that mechanical integrity may be offered preferably.

[Translation done.]

PATENT ABSTRACTS OF JAPAN

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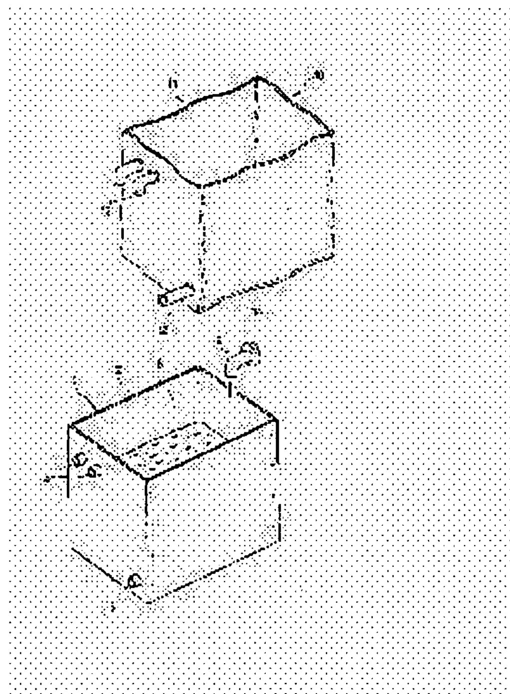
(72)Inventor : **NAGASHIO KICHINOSUKE**

(54) INNER-LINER POUCH FOR WATER TANK



(57)Abstract:

PURPOSE: To achieve a similar cleaning performance without requiring for a worker to enter a water tank to carry out tank cleaning by a method wherein a flexible film is formed into a shape having nearly the same dimensions as the internal dimensions of a water tank, and mounted inside the water tank.

CONSTITUTION: A material which is flexible, waterproof and hard to lose its shape is formed into a bag-like main body 11 of an inner-liner pouch 10. The shape and dimensions of the main body 11 is nearly the same as the interior shape and dimensions of a water tank 1 in which the inner-linear pouch is attached. On the main body 11, an outlet nozzle 12 and drain nozzles 13 are formed in one piece with the main body at positions corresponding to those of an outlet nozzle 3 and drain nozzles 4 of the water tank 1, and the nozzles 12 and 13 have sizes so that they are inserted through the nozzles 3 and 4 respectively. The inner-liner pouch 10 has an outside dimensions so that it comes into close contact with the inner wall of the water tank by the pressure of supplied water when it is attached in the water tank 1.

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Graham, John

From: Graham, John
Sent: Thursday, December 30, 2004 3:22 PM
To: Ford, John K.
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An English-language equivalent patent exists for the above-referenced JP Patent that you submitted for translation. Please take a look at EP 567,383 as it is cited as equivalent to the JP Patent in question. If, for any reason, you are not satisfied with this and still wish to obtain a translation of the JP Patent, please let us know so that we can process your initial request. If the equivalent is sufficient, we would appreciate a brief e-mail from you to that effect.

Thank you and have a Happy New Year!

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CY=JA DATE=19910225 KIND=A
PN=03-043390

INTERNAL BAG BODY FOR WATER TANK
[Mizutanku you naisou fukurotai]

Kichinosuke Nagashio

UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. January 2005

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APPLICANT	(71):	NAGASHIO, KICHINOSUKE
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FOREIGN TITLE	(54A):	MIZUTANKU YOU NAISOU FUKUROTAI

SPECIFICATION

1. Title of the Invention

Internal Bag Body for Water Tank

2. Claim

An internal bag body for a water tank characterized in that it is obtained by forming a film-shaped flexible material inside a box-type water tank, to and from which water is supplied and discharged, into a shape and external dimensions that are roughly the same as the internal dimensions of said water tank and in that it is then attached to the inside of said water tank.

3. Detailed Explanation of the Invention

[Field of Industrial Application]

The present invention pertains to water tank internal bag bodies that are installed inside water tanks that are utilized for water supply equipment and air-conditioning equipment in order to keep water stains from attaching to the inner walls of the water tanks.

[Related Art]

In tall office buildings and households, water tanks utilized for their water equipment and/or air-conditioning equipment are placed on the rooftops. Such water tanks are sized in accordance with the equipment and can store a few ~ 10 tons of water.

Figure 4 is a perspective drawing showing one example of a water tank.

The main unit [2] of the tank is obtained by shaping a sufficiently thick metal plate (e.g. iron plate) that can withstand water pressure into a box-shaped container, and the joint parts are connected by means

of, for example, welding so that the water filled inside will not leak.

Moreover, the upper part of the tank's main unit [2] is opened and the tank is normally used with or without a lid (not shown) on it. Moreover, a side wall of the tank's main unit [2] is provided with a release spout [3], which is for discharging the water inside the tank, and discharge spouts [4], which are for discharging the water above a specified level to the exterior. Moreover, the interior and exterior of the tank's main unit [2] have coatings on them for rust prevention.

According to a water tank having such a structure, a constant quantity of water is supplied continuously from a water supply spout [5] into the tank, or water is intermittently supplied by means of a water-supply control means (not shown), and the water is filled in a manner such that the level of water [6] does not exceed the discharge spout [4].

Incidentally, such a water tank has administrative regulations in order to secure health and safety, and periodical cleaning and inspection operations (e.g., once a year) in which water supply from the tank is discontinued in order to remove attachments (water stains, etc.) on the internal walls and suspended matters (dust, etc.) from the inside of the tank are mandated.

[Problems that the Invention is to Solve]

When cleaning such a water tank, the worker needs to enter the tank and manually clean it by using a cleaning tool such as a brush. Therefore, more times are required for larger tanks and the users are forced to bear the inconvenience during this time.

The purpose of the present invention was conceived in light of the above situation of the conventional technique and is to supply internal

bag bodies for water tanks that allow the same cleaning operations without the need for the worker to actually enter the tank.

[Means for Solving the Problem]

In order to achieve the above purpose, with respect to box-type water tanks to and from which water is supplied and discharged, a film-shaped flexible material is formed into a shape and external dimensions that are roughly the same as the internal dimensions of said water tank and is then attached to the inside of said water tank.

[Operation of the Invention]

According to the above means, an internal bag body that is roughly equal to a water tank in terms of dimensions and shape is attached inside the water tank so that water will not contact the inner walls of the water tank. Thus, a condition that is equivalent to the water tank having a double structure is achieved. Therefore, water stains become attached to the inner surfaces of the internal bag body, and inspection and cleaning can be accomplished by simply removing this internal bag body. Therefore, the water-supply outage time can be reduced.

[Working Example]

In the following, the present invention will be explained concretely by referring to Figs. 1 ~ 3.

Figure 1 is a perspective drawing showing one working example of an internal bag body of the present invention for water tank. Figure 2 is a partial cross-sectional drawing showing the internal bag body in the middle of installation. Figure 3 is a partial cross-sectional drawing showing the internal bag body after its installation has been finished.

As shown in Fig. 1, the main unit [11] of the internal bag body [10]

has been formed into a bag by using a material that is flexible, water resistant, and unlikely to lose its shape (e.g., a polymer material, such as a synthetic resin film). Its shape and size are made to be roughly the same as the internal dimensions of the water tank it will be applied to. Moreover, at the same locations as the release part [3] and discharge parts [4] of the water tank [1], the main unit [11] is provided with a release part [12] and discharge parts [13] that can be inserted into the release spout [3] and discharge spouts [4] of the water tank [1].

The external dimensions of the internal bag body [10] are set in a manner such that, when the internal bag body is attached, it becomes tightly attached to the inner walls of the water tank [1] by the pressure of the water supplied into the water tank [1]. If the external dimensions of the internal bag body [10] are smaller than the internal dimensions of the water tank [1], there is a risk that the internal bag body [10] with an insufficient strength becomes broken by the pressure of the water inside the internal bag body [10].

Moreover, there is no risk of the internal bag body [10] being broken if (internal dimensions of the water tank [1]) ≒ (external dimensions of the internal bag body [10]) is true in terms of the thickness of the main unit [11] as mentioned earlier. Therefore, it suffices to provide a degree of strength by which the bag does not break while being attached to or detached from the water tank [1]. Moreover, it is desirable that the bag be manufactured without any joints during the formation of the main unit [11] in order to keep airtightness. In reality, however, the corner parts are connected by means of thermocompression [14]. It is possible to utilize

adhesive tape, etc., instead of thermocompression.

Next, the method for attaching the thus-structured bag of the working example to the water tank [1] will be explained by referring to Figs. 2 and 3. It will be assumed that the internal bag body [10] has been selected based on its size that matches the internal dimensions of the water tank [1] to which it will be attached.

When attaching the internal bag body [10] to the water tank [1], the entire internal bag body [10] is inserted into the water tank [1] and the release part [12] is positioned by being matched to the main unit [2] of the water tank [1]. Next, as shown in Fig. 2, the discharge part [12] of the internal bag body [10] is inserted into the main unit [2] of the water tank [1] and, at the same time, the discharge parts [13] of the internal bag body [10] are inserted into the discharge spouts [4]. Next, as shown in Fig. 3, the bottom and the sides of the internal bag body [10] are attached to the bottom and sides of the water tank [1].

When water is supplied into the interior bag [10], the external surfaces of the internal bag body [10] comes into contact with the inner surfaces of the water tank [1], and the condition of the water tank [1] becomes the same as one in which there is a film formation on the internal walls of the water tank [1]. Therefore, water stains that have conventionally been generated on the internal walls of the water tank [1] become generated on the inner surfaces of the internal bag body [10] and not on the internal wall surfaces of the water tank [1].

Therefore, when it is time for regular inspection, all that needs to be done is to remove the internal bag body [10] from the water tank [1] and it becomes unnecessary to inspect and clean the water tank [1].

After removing the internal bag body [10] from the water tank [1], a new internal bag body [10] is attached to the water tank [1], and the inspection and cleaning operation is completed.

Since an internal bag body [10] is installed in this manner and the operation can be completed by simply replacing the internal bag body [10] at the time of regular inspection, etc., it becomes possible to greatly shorten the time required for the operation and the users will not be inconvenienced.

Moreover, although a water tank [1] that has a release spout [3] and discharge spouts [4] was the object in the above working example, the number and locations of the spouts vary depending on the installation conditions and the equipment, and the shape of an internal bag body [10] is also determined accordingly.

Moreover, if the water tank [1] is large, forming a bag body into the shape of a single bag increases the risk of damage. Therefore, a shape that is divided into multiple partitions (e.g., a beehive shape. The partitions should, at least partially, be connected to one another.) is preferred.

Moreover, although protrusions such as the release part [12] were simply inserted into the release spout [3] in the above working example, it is permissible to provide a fixture (e.g., washer, tightening cap, etc.) that fixates the internal bag body [10] to the wall surfaces of the water tank [1].

Moreover, although purified water was stored in the internal bag body [10] in the above explanation, the present invention can also be applied in the same manner to fluids other than water.

Moreover, although the water tank was metallic in the above working example, the present invention can be applied to tanks made from any materials other than metals, such as synthetic resins, woods, concrete, etc.

[Effects of the Invention]

As explained earlier, according to the present invention, an internal bag body is formed into a shape and external dimensions that are roughly the same as the internal dimensions of a box-shaped metallic water tank, to and from which water is supplied and discharged, by using a film-shaped flexible material and is attached to the inside of said water tank. Therefore, water stains, etc., become attached to the inner surfaces of the internal bag body, and an inspection and cleaning operation is completed by simply removing the contaminated internal bag body. Therefore, the water-supply stopping time can be shortened. As a result, the users will not experience inconvenience and the operability and safety can be increased.

4. Brief Explanation of the Drawings

Figure 1 is a perspective drawing showing one working example of an internal bag body of the present invention for a water tank. Figure 2 is a partial cross-sectional drawing showing an internal bag body in the middle of being attached. Figure 3 is a partial cross-sectional drawing showing an internal bag body after its attachment has been finished. Figure 4 is a perspective drawing showing one example of a water tank.

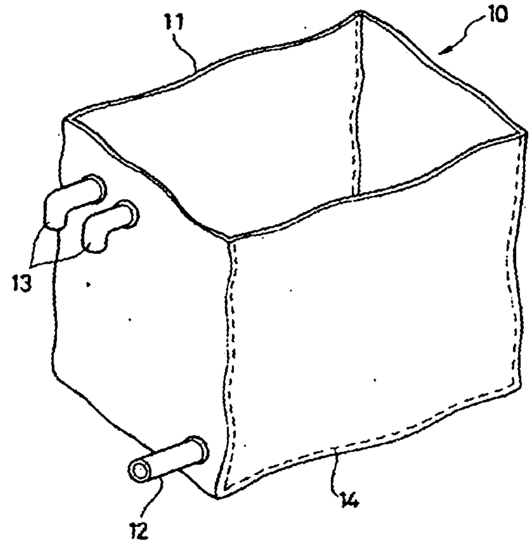

Figure 1

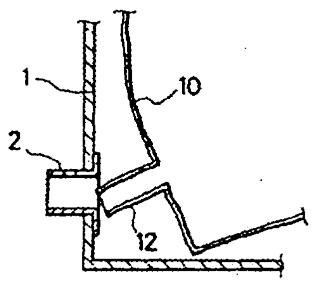

Figure 2

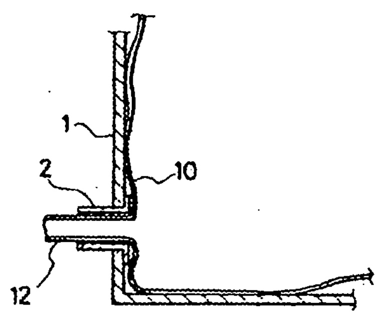

Figure 3

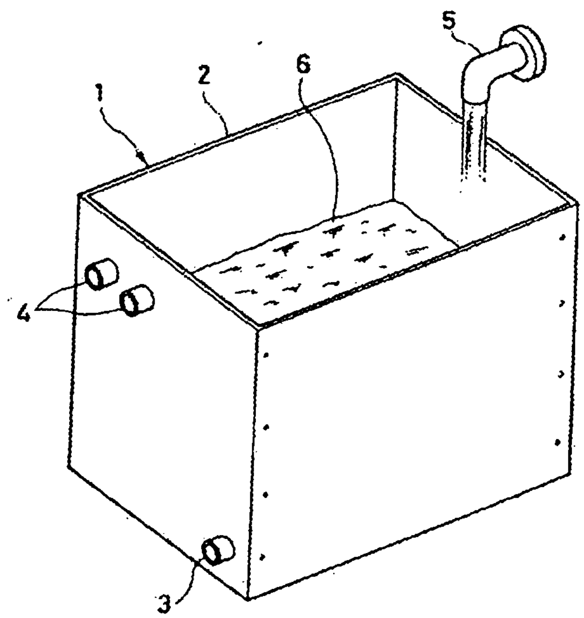

Figure 4

09/881,909

PTO 05-237

Japanese Kokai Patent Application
No. Sho 57[1982]-58087

CONTAINER FOR HEAT ACCUMULATING AGENT

Kozaburo Nakao and Hisao Takeda

UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. OCTOBER 2004
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Examination Request:	Not filed

CONTAINER FOR HEAT ACCUMULATING AGENT

[Chikunetsuzai yoki]

Inventors:	Kozaburo Nakao and Hisao Takeda
Applicant:	Kyoritsu Yuki Kogyo Kenkyusho K.K.

[There are no amendments to this patent.]

Claims

1. A container for a heat accumulating agent, characterized by the fact that several sheets of metallic plates with good heat conductivity are intersected and inserted into a cylindrical container in which a heat accumulating agent composition is housed.

2. The container for a heat accumulating agent of Claim 1, characterized by the fact that several sheets of intersected metallic plates have a cross or multiblade shape on a horizontal section of the container.

3. The container for a heat accumulating agent of Claim 1 or 2, characterized by the fact that the metallic plates have a number of through holes.

Detailed explanation of the invention

The present invention pertains to a container for a heat accumulating agent into which several sheets of metallic plates are intersected and inserted.

In general, the sensible heat or latent heat of a substance is utilized for accumulating heat; however, application of a heat accumulating agent depends on whether the sensible heat is used or the latent heat is used. As heat accumulating agents using sensible heat, water, gravel, crushed stone, etc., are mentioned, and these heat accumulating agents are useful since they can be easily handled, have a large specific heat, and are inexpensive. However, their volume and weight are very large. This is a disadvantage.

On the contrary, as heat accumulating agents using latent heat, crystalline substances of inorganic hydrates, etc., are mentioned. For example, calcium hexahydride chloride, etc., are mentioned. Since they utilize a phase change such as melting at a fixed temperature, the temperature decrease of the heat accumulating agent due to heat radiation is small, and since the latent heat for a phase change such as melting is generally significant, heat can be compactly accumulated. However, if the temperature of these salts is gradually lowered from the melting state or vice versa, extracting heat at a prescribed temperature is delayed, causing a practical inconvenience. Also, since the temperature conduction and convection of a substance in layers is poor, heat radiation is difficult. Therefore, faster heat conduction is needed.

Accordingly, these inventors variously reviewed the above problems to improve heat conduction in layers, and as a result, the problems were found to be solvable by inserting a metal with good heat conductivity into a cylindrical container for housing a heat accumulating agent. In other words, the present invention is a container for a heat accumulating agent characterized by the fact that several sheets of metallic plates with good heat conductivity are intersected and inserted into a cylindrical container in which a heat accumulating agent composition is housed.

Next, the present invention is explained in detail by figures.

In the case of a heat accumulating agent 1 accumulating collected solar heat, it is housed in a cylindrical container 2, and for example, in a method using an air as a heat collecting medium, heated air 4 is transferred to a heat accumulating chamber to heat the container 2 for the heat accumulating agent. Then, in a conventional container (Figure 1) in which only the heat accumulating agent is housed, melting of the heat accumulating agent starts only at the part of the heat accumulating agent in contact with the container wall as a result of heat from the outer periphery of the container for the heat accumulating agent, and the melting is sequentially advances toward the center. However, a very long time is required to finally melt the entire agent

after the melting has advanced. In addition, if the heat accumulating agent in a melted state radiates heat and its temperature is lowered, since the heat conduction is poor, a distinctly nonuniform distribution of the temperature is generated, and for this reason, heat cannot be extracted at a fixed temperature. Thus, several sheets of metallic plates with good heat conductivity such as plates of iron, copper, aluminum, and magnesium are intersected with each other at about the center of a horizontal section of the container and are inserted into the container. For example, as shown in Figure 2, (A) shows two sheets of metallic plates 5 intersecting each other in a cross shape, and (B) shows three sheets of metallic plates 5 intersecting each other in a multiblade pattern with the blades at a 60° spacing. Clearly, four or more sheets of metallic plates can also be used; however, if the number of sheets is too large, the amount of heat accumulating agent housed is decreased, and the cost is also quite high in accordance with the kind of metal, which is not preferable. In the cases shown in Figures 2(A) and (B), the part in contact with the container wall is melted, and the metallic plates 5 are heated by heat transfer from the melted heat accumulating agent 3. Heat is also transferred to the heat accumulating agent in the vicinity of the metallic plates by the heated metallic plates 5, and the vicinity of the metallic plates is melted, so that complete melting is rapidly completed. At the same time, if heat is radiated from the melted heat accumulating agent, heat transfer is fast. Then, when the heat accumulating agent reaches its melting point, the metallic plates act like crystal nuclei, and the heat accumulating agent is crystallized, so heat can be uniformly discharged.

In order to further improve the heat transfer by further improving the convection of the melted heat accumulating agent, holes with a round shape, square shape, star shape, etc., are bored at an appropriate density in part or over all of the metallic plates. These patterns also meet the objective of the present invention (6 in both (A) and (B) of Figure 3).

Thus, melting at a time of heating and solidifying at a time of radiating are smoothly carried out, so that heat is stably exchanged. Thereby, the heat accumulation density is high, and utilization of the heat is very efficient.

Brief description of the figures

Figure 1 is a plan view showing a conventional container for a heat accumulating agent. Figure 2 shows an application example of the container for a heat accumulating agent of the present invention into which metallic plates are inserted. (A) is a plan view showing the use of two sheets of metallic plates, and (B) is a plan view showing the use of three sheets of metallic plates. Figure 3 shows an application example of metallic plates in which holes are bored. (A) shows round holes, and (B) shows square holes.

1 Heat accumulating agent

2 Container

3 Melted heat accumulating agent
4 Hot air
5 Metallic plate
6 Hole

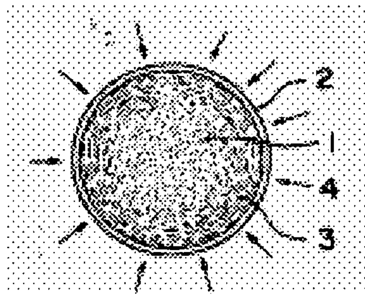

Figure 1

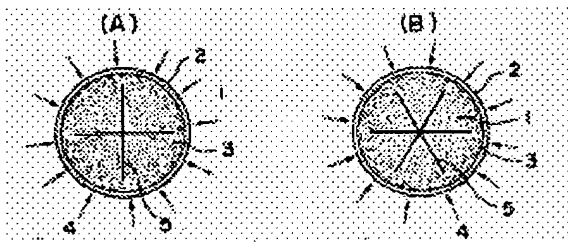

Figure 2

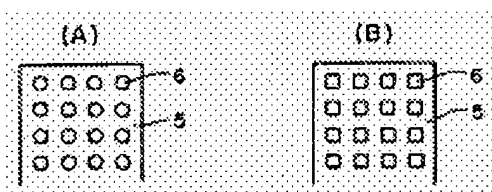

Figure 3